**University of Alberta**

*Respiratory Health of Inuit Stone Carvers*

by

*Karen Marie Tofflemire*

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the

requirements for the degree of *Master of Science*

in

*Medical Sciences – Public Health Sciences*

Edmonton, Alberta

*Spring 2003*

National Library of Canada
Acquisitions and Bibliographic Services
395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale du Canada
Acquisitions et services bibliographiques
395, rue Wellington
Ottawa ON K1A 0N4
Canada

*Your file Votre référence*

*Our file Notre référence*

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-82353-9

Canada

**University of Alberta**

**Library Release Form**

**Name of Author:** *Karen Marie Tofflemire*

**Title of Thesis:** *Respiratory Health of Inuit Stone Carvers*

**Degree:** *Master of Science*

**Year this Degree Granted:** *2003*

Permission is hereby granted to the University of Alberta Library to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly or scientific research purposes only.

The author reserves all other publication and other rights in association with the copyright in the thesis, and except as herein before provided, neither the thesis nor any substantial portion thereof may be printed or otherwise reproduced in any material form whatever without the author's prior written permission.

Karen Marie Tofflemire

*4020-17St. SW*
*Calgary, Alberta*
*T2T 4P4*

*Date submitted to the Faculty of Graduate Studies and Research:* January 31, 2003

**University of Alberta**

**Faculty of Graduate Studies and Research**

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *Respiratory Health of Inuit Stone Carvers* submitted by *Karen Marie Tofflemire* in partial fulfillment of the requirements for the degree of *Master of Science in Medical Sciences - Public Health Sciences.*

*Patrick Hessel, PhD*

*Robert Cowie, MD*

*Ambikaipakan Senthilselvan, PhD*

*Brenda Cameron, PhD*

*Date thesis approved by committee:* 28 Nov 2002

I would like to dedicate this work to my family,
Bill, Mary-Jane, Lisa, Andrew and Grams
*Thank you for teaching me how to follow my dreams*

**Abstract**

Artists in northern Canada carve with stones (commonly called "soapstone") that are diverse in mineralogical content. In recent decades, power tools have replaced traditional methods for shaping and sanding these artworks. This has resulted in the production of more dusts and finer particles. Exposure to these dusts could present a health hazard. This project was undertaken to determine whether stone carvers had increased prevalence of respiratory problems that may be related to their work.

The study included 464 participants from Nunavut. Methods consisted of an administered questionnaire, spirometry and chest radiographs. Carvers reported a statistically significant increased prevalence of respiratory symptoms suggestive of bronchial responsiveness, while symptoms of non-specific airway irritation were not found in excess. No significant difference in lung function was found between carvers and non-carvers. Little of evidence of radiographic abnormalities in relation to mineral dust exposure was noted.

**Acknowledgements**

I would like to extend my gratitude to the 464 men and women within the participating communities of Baker Lake, Gjoa Haven, Taloyoak and Cape Dorset, who shared their time to make this study possible.

Thanks to the community members who aided us in contacting participants, interviewing and confirming responses.

Special thanks to my supervisor, Dr. Patrick Hessel for providing me with this opportunity. I will forever be grateful for your guidance, support and belief in me.

I would also like to thank the members of the project team, Dr. Robert Cowie, Dr. Francis Green, Dr. Ken Yoshida and Mr. Dennis Michaelchuk for sharing their wisdom and including me in all aspects of this work.

I am appreciative to Dr. Ambikaipakan Senthilselvan for providing me with excellent statistical guidance and to Dr. Brenda Cameron for her enthusiastic participation during my thesis defense.

Thanks to Faith Studds and Marilyn Dixon for spending time in the north collecting the data.

I would also like to thank the Baffin Regional Hospital and the Health Centres within the communities for assistance provided to our study team.

Thanks to Dr. Richard Jones, Dr. W. Keith Morgan and Dr. Paul Burrows for providing guidance and interpretation of spirograms and chest radiographs.

Appreciation goes to the Canadian Institutes of Health Research for funding of this study.

I would also like to thank my fellow students and the Department of Public Health Sciences for their support, particularly Felicity Hey, Kathleen Forbes and Kathy Poulin for always providing assistance.

Finally, thank you to my friends and family. I am overwhelmed with the amount of love and support that you have provided me with throughout this journey.

**Table of Contents**


**Chapter 1: Introduction** ..... 1

1.1 The Inuit ..... 1

1.2 Nunavut – Geography and Climate ..... 2

1.3 Inuit Health ..... 3

1.3.1 Health Status ..... 3

1.3.2 Respiratory Morbidity and Mortality of the Inuit ..... 5

1.3.3 Tobacco Use ..... 6

**Chapter 2: Background and Rationale** ..... 8

2.1 History of Inuit Carving ..... 8

2.2 Carving Stone ..... 9

2.3 Hygiene Investigation ..... 11

2.3.1 Carving Environment ..... 12

2.3.2 Carver Dust Exposure ..... 12

2.3.3 Current Respirator Use ..... 14

2.3.4 Risk Assessment ..... 14

**Chapter 3: Literature Review** ..... 16

3.1 Occupational Lung Diseases and Inorganic Dust Exposure ..... 16

3.2 Key Studies ..... 20

3.2.1 Community Prevalence Studies of Occupational Dust Exposures 20

3.2.2 Mining, Stone Crushing and Cutting ..... 21

3.3 Smoking and Respiratory Health in Dust Exposed Populations ..... 26

3.4 Summary ..... 27

**Chapter 4: Methods and Materials** ..... 28

4.1 Study Objective ..... 28

4.2 Study Design ..... 28

4.3 Sampling and Recruitment of Participants ..... 29

4.4 Inclusion and Exclusion Criteria ..... 30

4.5 Sample Size ..... 30

4.6 Data Collection ..... 31

4.6.1 Questionnaires..... 31
4.6.2 Spirometry..... 31
4.6.3 Chest Radiographs..... 32
4.7 Data Management..... 32
4.7.1 Questionnaires..... 32
4.7.2 Spirometry..... 32
4.7.3 Chest Radiographs..... 33
4.8 Data Analysis..... 34
4.8.1 Descriptive Analysis..... 34
4.8.2 Respiratory Symptoms..... 34
4.8.3 Lung Function..... 38
4.8.4 Chest Radiographs..... 41
4.9 Ethical Implications..... 43
4.10 Dissemination..... 44

**Chapter 5: Descriptive Results**..... 45
5.1 Study Participation..... 45
5.2 Demographic Information..... 47
5.3 Tobacco Use..... 47
5.4 Past Illnesses and Allergies..... 48
5.5 Home Environment..... 49
5.6 Occupational Exposures..... 49
5.7 Carving Practices..... 50

**Chapter 6: Results – Symptoms**..... 66
6.1 Prevalence of Respiratory Symptoms and Bivariate Associations..... 66
6.2 Multivariate Analyses..... 69
6.3 Carving Media and Respiratory Symptoms..... 72
6.4 Exposure-response..... 72

**Chapter 7: Results - Lung Function**..... 91
7.1 Adult Inuit Lung Function..... 91
7.2 Lung Function Comparisons between Carvers and Non-carvers..... 92
7.2.1 Bivariate Analysis..... 92
7.2.2 Multivariate Analysis..... 95

7.2.3 Exposure-response....96

**Chapter 8: Results – Chest Radiographs**.... 108

8.1 Quality of Chest Radiographs.... 108

8.2 Parenchymal Abnormalities.... 109

8.3 Pleural Abnormalities.... 110

**Chapter 9: Discussion**.... 112

9.1 Stone Carvers.... 112

9.2 Respiratory Symptoms.... 113

9.3 Lung Function.... 114

9.4 Chest Radiographs.... 116

9.5 Strengths and Limitations.... 116

9.5.1 Strengths.... 117

9.5.2 Limitations.... 117

9.6 Sample Size and Statistical Power.... 120

9.7 Conclusions.... 121

9.7.1 Summary of Findings.... 121

9.7.2 Future Research.... 122

**References**.... 124

**Appendices:**

A. Map of Nunavut, Canada....135

B. Questionnaire (English version)....137

C. Acceptability and Reproducibility Criteria (ATS)....153

D. Information Sheet for Participants....155

E. Consent Form....158

F. Study newsletter....160

G. Prediction equations (Crapo 1981)....163

## List of Tables


Table 2.1 Rank of exposure episode by exposure index....13

Table 5.1 Demographic information for carvers and non-carvers....52

Table 5.2 Comparison of cigarette smoking characteristics of carvers and non-carvers...53

Table 5.3 Tobacco use (other than cigarettes) for carvers and non-carvers....54

Table 5.4 Comparison of past illnesses reported by carvers and non-carvers....55

Table 5.5 Comparison of allergic symptoms reported by carvers and non-carvers....56

Table 5.6 Comparison of home environment between carvers and non-carvers....57

Table 5.7 Industries where exposure to vapours, gas, dust or fumes occurred for carvers and non-carvers....58

Table 5.8 Types of occupational exposures reported by carvers and non-carvers....59

Table 5.9 Individual jobs left or changed due to breathing difficulties in various occupations....61

Table 5.10 Carving production by community of residence....62

Table 5.11 Seasonal carving venue by community of residence....63

Table 5.12 Dust mask usage by community of residence....64

Table 5.13 Injuries incurred during carving by community of residence....65

Table 6.1 Bivariate association of selected variables with usual cough....75

Table 6.2 Bivariate association of selected variables with chronic cough....76

Table 6.3 Bivariate association of selected variables with usual phlegm....77

Table 6.4 Bivariate association of selected variables with chronic phlegm....78

Table 6.5 Bivariate association of selected variables with shortness of breath....79

Table 6.6 Bivariate association of selected variables with wheeze (past 12 months, without a cold present)....80

Table 6.7 Bivariate association of selected variables with wheeze associated with chest tightness....81

Table 6.8 Bivariate association of selected variables with chest tightness....82

Table 6.9 Bivariate association of selected variables with attacks of wheeze with shortness of breath....83

Table 6.10 Logistic regression model – usual cough....84

Table 6.11 Logistic regression model – chronic cough....84

Table 6.12 Logistic regression model – usual phlegm....85

Table 6.13 Logistic regression model – chronic phlegm....85

Table 6.14 Logistic regression model – shortness of breath....86

Table 6.15 Logistic regression model – wheeze (past 12 months, without a cold present)....86

Table 6.16 Logistic regression model – wheeze associated with chest tightness....87

Table 6.17 Logistic regression model – chest tightness....87

Table 6.18 Logistic regression model – attacks of wheeze with shortness of breath....88

Table 6.19 Odds ratios (95% confidence interval), symptoms in relation to carving media used, compared to non-carvers....89

Table 6.20 Odds ratios (95% confidence interval), symptoms in relation to years of Carving, compared to non-carvers....90

Table 6.21 Odds ratios (95% confidence interval), symptoms in relation to number of Pieces carved, compared to non-carvers....90

Table 7.1 Physical characteristics and lung volumes/flow rates (unadjusted) of Inuit from Nunavut....98

Table 7.2 Regression equations for spirometric parameters in Inuit males and Females....99

Table 7.3 Measured Inuit spirometry values compared to Crapo (1981) prediction equations....100

Table 7.4 Comparison of mean FVC (l) values for selected variables....101

Table 7.5 Comparison of mean $FEV_1$ (l) values for selected variables....102

Table 7.6 Comparison of mean $FEV_1/FVC$ values for selected variables....103

Table 7.7 Comparison of mean $FEF_{25-75}$ (l/s) values for selected variables....104

Table 7.8 Multivariate analyses of selected spirometric parameters, with adjusted means for male carvers and non-carvers....105

Table 7.9 Multivariate analyses of selected spirometric parameters, with adjusted means for female carvers and non-carvers.....105

Table 7.10 Adjusted mean and 95% CI presented as percent of predicted Crapo (1981) spirometric values for carvers and non-carvers.....106

Table 7.11 Adjusted mean (95% CI) of selected spirometric parameters for pieces of art carved over career.....107

Table 7.12 Adjusted mean (95% CI) of selected spirometric parameters for years of carving.....107

Table 8.1 Comparison or ratings of the quality of x-rays between reader 1 and reader 2.....109

Table 8.2 Spirometry parameters (observed and percent of predicted) for participant displaying signs of parenchymal abnormalities consistent with pneumoconiosis.....110

Table 8.3 Spirometry parameters (observed and percent of predicted) for participant displaying signs of pleural abnormalities consistent with pneumoconiosis.....111

Table 9.1 Statistical power of selected analyses, dichotomous variables.....121

Table 9.2 Statistical power of selected analyses, continuous variables.....121

## List of Figures


Figure 1.1 Mortality rates by major cause, NWT and Canada, 1991-1996.....4

Figure 1.2 Smoking practices for NWT/Canada, 1994/1995.....7

Figure 2.1 History of Inuit carving .....15

Figure 5.1 Study participation.....46

Figure 6.1 Prevalence of symptoms reported by carvers and non-carvers.....69

Figure 6.2 Adjusted odds ratio and 95% confidence intervals for selected respiratory symptoms, comparing carvers to non-carvers.....71

Figure 6.3 Exposure too stone dust assessing years of carving and amount of pieces carved.....74

## List of Abbreviations

AD = Anno Domini

ANCOVA = Analysis of Covariance

ATS = American Thoracic Society

BC = Before Christ

BTPS = Body temperature, ambient pressure, saturated with water vapour (gas)

BZ = Breathing Zone

CAS = Chemical Abstract Service

CI = Confidence Interval

COPD = Chronic Obstructive Pulmonary Disease

DHHS = Department of Health and Social Services

EI = Exposure Index

$FEF_{25-75}$ = Forced Expiratory Flow during the middle half of the FVC

$FEV_1$ = Forced Expiratory Volume in one second

FVC = Forced Vital Capacity

GNWT = Government of the Northwest Territories

ILO = International Labour Organization

NHRDP = National Health Research Development Program

NWT = Northwest Territories

OEL = Occupational Exposure Limit

OR = Odds Ratio

OSHA = Occupational Safety and Health Administration

RF = Risk Factor

SD = Standard Deviation

SEE = Standard Error of the Estimate

SOB = Shortness of Breath

SPSS = Statistical Package for the Social Sciences

STEL = Short Term Exposure Limit

TWA = Time Weighted Average

# CHAPTER 1: INTRODUCTION

This chapter provides a brief overview of the Inuit people. Over the past century dramatic changes have taken place within this culture. A description of the study location, Nunavut, is provided, followed by an overview of the health status of this population, focusing on respiratory morbidity and mortality.

## 1.1 The Inuit

The Inuit are masters of adaptation in the harsh Canadian arctic environment. The term Inuit is the plural of Inuk and means "the people" or "human beings". The term Inuit was officially adopted at the 1977 Inuit Circumpolar Conference to replace the term Eskimo (Crandall 2000). The traditional Inuit were a semi nomadic hunting people who travelled together in small bands and extended families, combining their knowledge and resources to survive.

Sustained contact with Europeans and Americans began to take place in the early nineteenth century as the search for the Northwest Passage began, along with the arrival of whalers and traders. By the late nineteenth and early twentieth century, missionaries were established in the arctic, along with trading posts. Throughout the 1950s, the Canadian government established small villages and towns equipped with schools and nursing stations around the existing trading posts and missions (Hessel 1998). A quote from one Inuit elder captures the changing Inuit experience:

> *"I know I have had an unusual life, being born in a skin tent and living to hear on the radio that two men have landed on the moon"* (Eber 1977).

Today, approximately 41,000 Inuit live in Canada (Statistics Canada 1996), most throughout Labrador, Nunavik (Arctic Quebec), the Northwest Territories and Nunavut. The modern Inuit village is connected to southern Canada by scheduled flights. Huge diesel generators provide electrical power, and many live in energy-efficient homes. However, it is evident

today that Inuit are still connected to their roots. When the opportunity arises, Inuit leave their communities and live on the land for some time.

## 1.2 Nunavut – Geography and Climate

Nunavut received its official distinction on April 1st, 1999, becoming the newest territory in Canada. It's population of approximately 26,000 (Statistics Canada 1996), is scattered across 1,900,000 sq.km. Nunavut covers approximately 1/5 of Canada, stretching from Ellesmere Island off Greenland's north coast to a border that runs north from the Saskatchewan/Manitoba border and then angles west to the arctic coast near Amundsen Gulf. A map of Nunavut is found in Appendix A.

The arctic mainland consists of lakes and rivers, while mountains and fiords dominate the eastern islands. Much of the land is tundra, where trees cannot survive, stunted plants grow slowly and lichens cling to rocks. The oceans are frozen for much of the year, and permafrost keeps the ground frozen, except at the height of summer, when the top few centimetres thaw (Hessel 1998).

Winters are cold and dark, lasting six to seven months of the year with temperatures falling to an average of -30 °C to -40°C in January, and occasionally -60°C. In the most northerly regions, the sun disappears completely for three months. Summers last a few months, with an average temperature ranging from 5°C to 15°C, and are filled with long hours of sunlight.

Despite the harsh climate, the Arctic supports over eight hundred species of plants, several hundred animal species and a few dozen bird species.

## 1.3 Inuit Health

### 1.3.1 Health Status

The population in both the Northwest Territories and Nunavut is comparatively young. In 1996, 37% of the population was under the age of 20, compared to 27% nationally, while only 4% were 65 or older, compared to 12% nationally. Life expectancy has been increasing steadily over the past two decades. Aboriginal women have seen their life expectancy increase from less than 70 years in 1980 to 75 years in 1997. Life expectancy in Aboriginal men increased from about 60 years in 1980 to almost 70 years in 1997 (Department of Health and Social Services 1999).

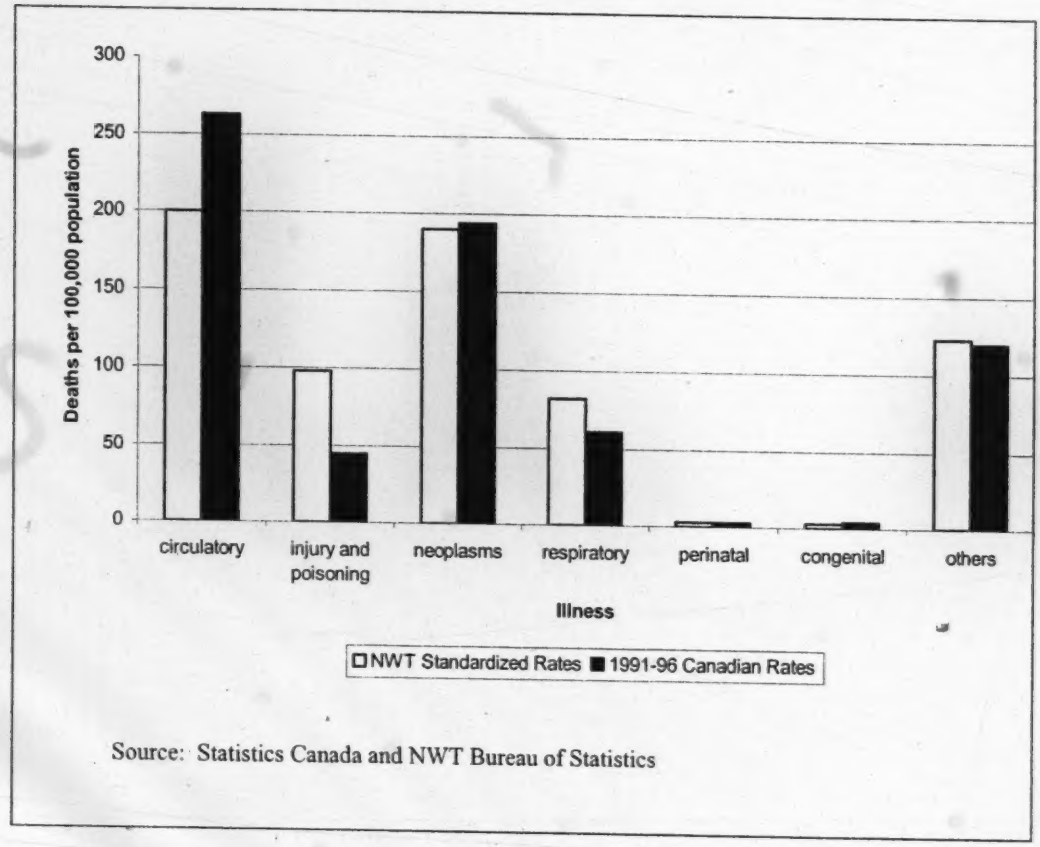
During the last fifty years, the Inuit experienced great amounts of change in relation to lifestyle, occupation, socio-cultural interactions and nutrition. In addition, the health picture of the Inuit has changed. In an earlier observation period, the Inuit showed a vastly different epidemiology compared with other North Americans (Schaefer and Hildes 1993).

During contact with outside populations, prior to the 1960s, the health care of Northern Canadian Aboriginal populations was dominated by efforts to curb acute and chronic infectious diseases. Deep indentations were seen in birth cohorts related to severe, local, first time epidemics (Waldram et al 1995). For example, in the Cumberland Sound population, the Royal Canadian Mounted Police population list of January 1965 showed marked deficits in the 20-24 age group, corresponding to the 1940-44 birth years. In 1941/1942 a typhoid fever epidemic killed 12% of the area's population, severely affecting women of childbearing age (Schaefer and Hildes 1993).

Changes in health of the Inuit over the past few decades include a marked increase in gallstones, hypertension, diabetes mellitus and degenerative cardiovascular diseases, previously unknown or rarely observed in the Inuit (Schaefer 1973; Young 1986; 1990). Figure 1.1 shows the age-adjusted mortality rates for the most common illnesses in the Northwest Territories, compared to Canada for the years 1991-1996. Rates of cancer in the Northwest Territories are about the same as for the rest of Canada and mortality due to circulatory disease is lower than the rest of Canada. Mortality due to respiratory illness is higher than the rest of the country and mortality due to injuries in the north is more than twice the rate for the rest of Canada (DHSS 1999).

The patterns of neoplastic diseases observed in the Inuit changed from 1950 to 1980. The occurrence of traditional Inuit tumours such as naso-pharyngeal, salivary gland, kidney and oesophagus cancers decreased, and those originating in the lung, cervix and colon increased from a low to a high incidence (Hildes and Schaefer 1984).

Figure 1.1 Mortality rates by major cause, NWT and Canada, 1991-1996




Source: Statistics Canada and NWT Bureau of Statistics

### 1.3.2 Respiratory Morbidity and Mortality of the Inuit

Respiratory problems are common among the Inuit and northern communities. Approximately one quarter of visits to community health clinics is attributed to diseases of the respiratory system (DHSS 1999). Avtsyn (1985) demonstrated that both newcomers and native residents of the north frequently have higher prevalence of chronic bronchitis and other non-specific pulmonary diseases as compared to residents of the central latitude regions.

When looking at cancer of the respiratory system in circumpolar Inuit, Miller and Gaudette (1996) found that incidence rates of lung cancer were high in Inuit populations of Alaska, Greenland and Canada. In each of the time periods considered between 1969-1988, and in each sex, the age-standardized incidence rates were the highest in Canadian Inuit. Bowerman (1998) noted that within the Inupiat population of Alaska, lung cancer had emerged as the prominent cancer, representing 25% of all cancers for the 1987-1994 period. The male lung cancer rate for this period was 137 per 100, 000 (95% CI=73-201). Female rates were lower at 27 per 100, 000 (95% CI=0-58).

Tuberculosis case rates in Canadian Inuit have been among the highest recorded in a human population. Notifications of active tuberculosis reached 1000 per 100,000 in the 1950s (Grzybowski et al 1976). Following systematic medical and radiological surveys, hospitalization and the advent of efficient chemotherapy, rates declined rapidly and drastically during the 1960s (Enarson 1998). However, this decreased rate of tuberculosis in the Inuit population, and Canadian aboriginals as a whole, lagged behind the nonaboriginal Canadian population. In 1970, the aboriginal rate of tuberculosis was 12 times higher than the nonaboriginal rate, with 212 cases per 100,000 population compared with 17. In 1995, the aboriginal rate was 39 times higher, with 70 cases per 100,000 population compared with 1.8 per 100,000 nationally (Hoeppner and Marciniuk 2000).

As long as reliable medical reports have been available, it has been noted that respiratory tract infections have been a leading cause of morbidity and mortality in northern native children (Maynard and Hammes 1970; Karron et al 1999). In 1965, Brody found that 35% of Alaska native children had at least one episode of pneumonia or bronchitis during the first year of life, and 75% of post neonatal infant deaths were due to respiratory infections. Singleton et al (2000) found that a high prevalence of bronchiectasis in Alaska native

children (prevalence: 15 per 100,000 in 1980) appeared to be related to extremely high rates of infant and childhood pneumonia and other lower respiratory infections. Banerji et al (2001) found that Inuit infants in the Baffin region experience a high rate of hospital admissions for lower respiratory infections (484 per 1000 infants who were less than 6 months of age).

Reports of asthma in Inuit and aboriginal communities were rare prior to 1976. Investigation of records at the Charles Camsell Hospital in Edmonton, for the period 1946-73, showed that for Canadian Inuit, there were only 3 of 5000 total admissions attributed to bronchial asthma (Herxheimer 1974).

However, the prevalence and incidence in this population has been increasing over the last two decades. The rates are becoming comparable to that of the general population. In 1999, Stout et al found that the weighted prevalence of parent-reported asthma was comparable for native and non-native children. They reported the prevalence for American Indian and Alaska Native children age 1-17 years was 7.06%, compared to a US prevalence estimate of 8.40%.

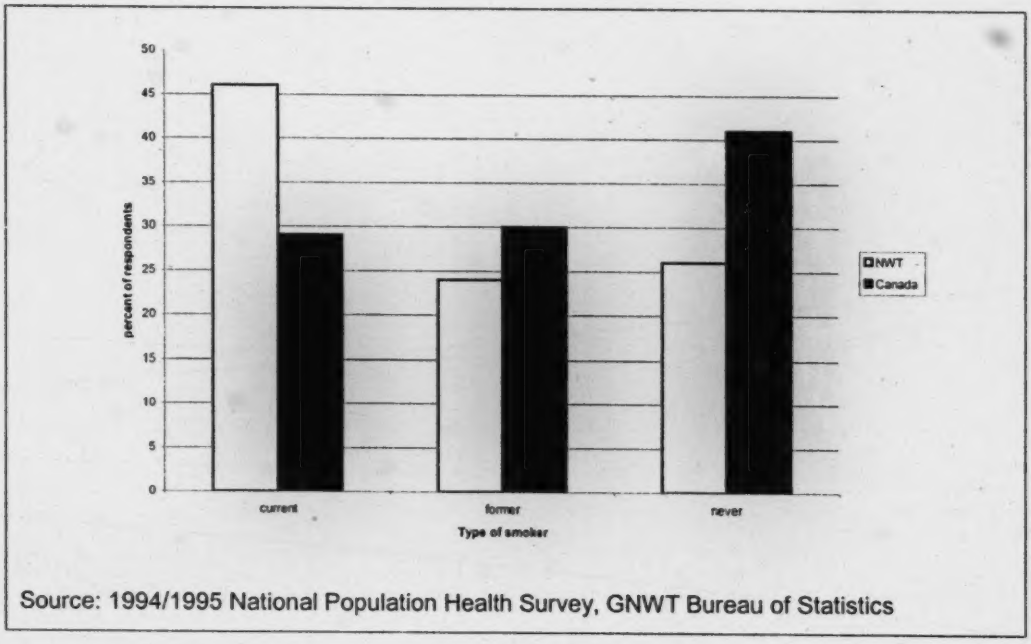
Senthilselvan and Habbick (1995) investigated asthma morbidity in children and adults among Registered Indians in Saskatchewan using hospitalization data for 1970-1989. Even though asthma was reported to be rare among Indians before 1975, they observed increases in asthma morbidity in recent years among children and young adults. Compared to other Saskatchewan populations, the Indian population had significantly increased risk for hospitalization in the age groups 0-4 and 35-64 years.

### 1.3.3 Tobacco Use

The effects of tobacco smoke, directly inhaled or second-hand, have been linked to cancer, cardiovascular disease and respiratory problems. Smoking is considered the most important preventable cause of death in the developed world, and is the number one preventable cause of death in Canada (Federal, Provincial Territorial Advisory Committee on Population Health Canada 1996).

According to the 1994/1995 National Population Health Survey, the Northwest Territories had a rate of smoking much higher than that of Canada. As can be seen in figure 1.2, more than 45% of Northwest Territories residents 12 years of age and older, reported being current smokers compared to less than 30% nationally. Only 26% of Northwest Territories residents reported never smoking compared to more than 40% nationally. Millar (1990) reported that in Arctic Canada, by age 15-19, 43% of non-native youth, 63% of Dene youth and 71% of Inuit youth were current cigarette smokers.

Figure 1.2 Smoking practices for NWT/Canada, 1994/1995




Source: 1994/1995 National Population Health Survey, GNWT Bureau of Statistics

## CHAPTER 2: BACKGROUND AND RATIONALE

The purpose of this chapter is to provide background information concerning the art of stone carving. Carving, from both an artistic and economic viewpoint, is an important aspect of Inuit life. This chapter outlines the history of carving and provides information on the stone material used in this art. In addition, a summary of an occupational hygiene investigation, conducted with a sub sample of this study population, is included in order to provide information on carving practices and dust exposure.

### 2.1 History of Inuit Carving

Carving artworks is deeply embedded in the Inuit culture. Sculptures have a long and diverse history. The literature tells a story of defined periods of art dating from prior to 1800 BC and leading to the present. Figure 2.1 outlines the history of Inuit carving.

The Prehistoric period includes three distinct cultures over time producing carvings. Although not much is known about the art of the Pre-Dorset culture (~1800 BC – 800 BC), intricately carved tools have been documented (Hessel 1998). The Dorset culture (~800 BC-AD1450) produced detailed pieces, mainly composed of ivory, antler or bone. The Thule culture (~AD1000-1600) produced more functional items such as games and toys, again with ivory as the prominent carving material (Crandall 2000).

The Historic period (~AD 1700s-1940s) saw a change in the function of carvings. With the exploration of the north, the stabilized contact with whalers, the settling missionaries and traders, art became a trade commodity. Ivory was still the preferred material of choice, but antler, bone and stone were also used. Carvings, representing traditional life of the Inuit, were preferred by collectors, and artists produced work according to the likes of an outside audience (Crandall 2000).

The greatest and most rapid change in Inuit carving history took place during the Contemporary period (1940s-present). James and Alma Houston are names intimately entwined with catapulting the contemporary art period. In 1948 they were pivotal in raising

awareness of Inuit carvings and helping with the establishment of Canadian Arctic Producers Ltd. Over the past fifty years, Inuit art has become a large part of the northern economy, with current consumption of carving stone at approximately 650 tonnes annually, with a retail value of $17 million. The importance of carving was noted in the Nunavut Land Claim Agreement signed in 1993. It enshrined the right of every Inuk to remove 50 cubic yards per year of carving stone from Crown lands without a permit (Gustavison 1999).

In a 1964 article, Martijn noted five differences in the contemporary period from the previous periods: media, size, function, motif, and style. Since the publication of this article a sixth difference has emerged: techniques. The shift from ivory to carving stone occurred because the demand for art was greater than the supply of ivory and there were restrictions on exporting and importing ivory.

There are also differences in the art pieces produced. In the past, most were small and lightweight. With stone as media, the size of carvings could be made larger, and generally resulted in higher prices (Crandall 2000). The techniques used for producing art have changed dramatically over the last twenty years. In the past the tools used were relatively "crude", such as hatchets, broken saw blades, bow drills, axes and files. Today, power drills with diamond-tipped bits are commonly used. It is this last period of contemporary art production where respiratory health concerns have been raised.

## 2.2 Carving Stone

Carving stone encompasses a broad range of rock types that can be fashioned into sculptures. The term carving stone has incorrectly been used synonymously with soapstone. "Soapstone", or more accurately, steatite, is a rock containing a high proportion of the mineral talc, which gives the stone its soapy or waxy feel. Steatite is just one type of rock used to make sculptures (Gustavison 1999).

There are three major categories of rocks that form on the crust of the earth: igneous, metamorphic, and sedimentary (classified by how they were formed). The building blocks of rocks are minerals. Most rocks contain a combination of minerals, although some are dominantly one mineral. Geologists discuss types of rock (and minerals) by a combination of

characteristics, including hardness, cleavage, fracture, colour and lustre, streak, and specific gravity (Jackson and Bates 1987).

Hardness of a rock can be examined by resistance to scratching (Jackson and Bates 1987). Mohs hardness scale is used, ranging from 1 (represented by the mineral, talc) to 10 (represented by diamond). Hardness determines what type of tools the artist must use while carving, as well as the polish and durability of the finished artworks.

The cleavage and fracture in the minerals, and in the rock as a whole, will determine how, and how easily, the rock breaks, and if it will break along a preferred direction (Jackson and Bates 1987).

Colour gives unique characteristics to each finished piece of art. The variety of colours range from soft pastel colours and pearly lustre of the marbles, to the waxy lustre and light greens of the soapstone, to the enlivening lustre of well-polished green and brown serpentines. The colours of the stones are largely dependent on the minerals present in the different rocks (Jackson and Bates 1987).

Streak refers to the colour of the powder produced when a specimen is rubbed on an unglazed porcelain tile or, if it is very hard, the colour of the powder when the mineral is crushed by a hammer (Pellant 1992).

The majority of stone used by artists comes from quarrying sites in their area, although this varies between artists. The Government of the Northwest Territories has documented carving stone occurrences in the north (McDermott 1992). Collected information includes: location and access to the quarry, geology, and site assessment. The types of rocks documented vary between quarries across Nunavut, providing some regional differences.

In the hamlet of Cape Dorset, on the south-west coast of Baffin Island, a large amount of carvings are produced from serpentinites, with a green colour. Serpentinite is a rock consisting almost wholly of serpentine-group minerals; e.g. antigorite, chrysotile, or lizardite derived from the alteration of previously existing ferromagnesian, silicate minerals such as olivine and pyroxene (Pellant 1992). Accessory chlorite, mica, chromites and talc may also

be present. Marble is also found in quarries in the Cape Dorset area. Marble is formed by the metamorphism of limestone.

In the Keewatin Region, where the community of Baker Lake is located, stones are quarried from a large geological area. A considerable amount of the stone used is comprised of serpentine, with relative hardness, largely a consequence of the higher amount of chlorite or biotite mica present (McDermott 1992). Steatite ("soapstone") is also commonly quarried.

The communities of Gjoa Haven and Taloyoak are located in the Kitikmeot region in Nunavut. Artists in this area travel distances to reach the quarries. Most stones can be classified as serpentines. Some samples contained fine crystals of tremolite, a secondary magnesium-iron-silicate mineral (McDermott 1992).

In 1992 the project team received formulation funding under the North of 60 research program of the National Health Research Development Program (NHRDP), which laid the groundwork for this investigation. During this formulation phase, 74 samples of carving stone from various sites in Nunavut and the Northwest Territories were analysed using X-ray diffraction, energy dispersive X-ray analysis and/or transmission electron microscopy (Green et al 1993).

Many of the samples identified talc (66% of samples) and chlorite (45%). Also noted were tremolite (19%), gypsum (9%), dolomite (4%), and chrysotile (7%). The 5 samples in which chrysotile was identified contained asbestos fibres and bundles.

## 2.3 Hygiene Investigation

Occupational hygiene investigations provide an in-depth study of the job process, including: materials and methods used, safety equipment employed, quantitative assessments of exposure levels, and risk assessments.

Previously, no complete occupational hygiene investigations have been completed for the Inuit carving industry. During the course of this study, an investigation was completed including 48 active carvers (Yoshida 2001). Assessments were made of the materials and

methods used in the carving process, the amount of time spent working, and workplace concentrations of dusts. Methodology, limitations, recommendations and further details for the investigation are detailed in Yoshida (2001). The following sections are summaries from the report.

### 2.3.1 Carving Environment

The territorial regulatory guidelines for soapstone no longer allow carving operations inside living spaces. During the site investigation, the majority of stone carving operations were performed outdoors in extremely cold winter conditions (minus 25-35 degrees C). Only a few carvers had indoor workshops with natural ventilation that were separated from their residences.

A commonly accepted work practice is for the carver to sit on a stool facing at a right angle to the direction of the prevailing wind. The size and intensity of air turbulence, the size of stone-tool contact, and type of tools affected the nature of dust generation and dispersion. The size of dust plumes varied from the size of a palm (10 cm diameter) to a giant dust cloud reaching a neighbour's home (5 m wide, and 20 m long).

### 2.3.2 Carver Dust Exposure

Estimation of work exposure to potential health hazards was the most difficult task in the hygiene investigation. Provincial and territorial regulatory agencies in Canada have set occupational exposure limits for soapstone, but no Chemical Abstract Service (CAS) number as a chemical substance is assigned.

The occupational exposure limit (OEL) for soapstone, as an 8-hour, time weighted average (TWA), is 6 $mg/m^3$ for the inhalable mass portion, and 3 $mg/m^3$ for the respirable mass portion (Government of Alberta 2002). The current OEL has no short-term exposure limit (STEL for 15 minute sampling) for soapstone. STEL is recommended only where toxic effects have been reported from high short-term exposures in either humans or animals. Soapstone is not designated as an irritant.

Concentrations of respirable dust in the breathing zones ranged from 1 mg/ $m^3$ to 14.6 mg/$m^3$ as short term mean values (measured background level). Breathing zone (BZ) is defined as an imaginary sphere of air space around a workers head, having a diameter of 60 cm. The volume of air inside the BZ is usually inhaled by the worker at normal physical work (American Conference of Governmental Industrial Hygienists 1999). Values described in this investigation were based on the ratio of BZ concentrations to the TWA of 3 mg/$m^3$ for the respirable portion of the dust. This was referred to as the exposure index (EI), expressed as a percent. EI values varied from 3.3 to 493.3%. Each exposure episode was ranked into EI groups. The majority of them (66%) were at background to low index groups (table 2.1). The majority of operations with hand tools, such as hand hatchet and file, produced dust at the background level. Gross shaping with high-speed power tools, such as an angle grinder produced higher levels of dust exposure. Power tool users are subject to exposures up to 90 times those of the hand tool users.

It should be noted that dust inhalation exposure has drastically changed since the introduction of high-speed power tools compared to traditional hand hatches and file methods. This gradual transition of tool use is believed to have occurred during the 1980s.

Table 2.1 Rank of exposure episode by exposure index

| Rank (index group) | Exposure Index (EI) | n (%) (N=41 episodes) |
|---|---|---|
| High | >200% | 4 (9.8) |
| Moderately High | 150-200% | 3 (7.3) |
| Medium | 100-150% | 7 (17.1) |
| Low | 20-100% | 14 (34.1) |
| Moderately Low | 1-20% | 6 (14.6) |
| Background Level | <1% | 7 (17.1) |

### 2.3.3 Current Respirator Use

Among 32 subjects in 4 hamlets, 43.8% used some type of respiratory protection. However, one half of active carvers, including the 3 female participants, did not use any kind of mask.

The use of an improved mask (identified as an R mask) has been recommended by the Territorial government. The R mask is equipped with a separate exhaust port that minimizes fogging of safety glasses by moist and warm air exhaled during cold working conditions. At each sampling site, individual carvers were asked to voluntarily try an R mask after a simple fit test. The acceptance of the R mask rose to 62.5%, but 12.5% had conditional acceptance, and 15.6% were still reluctant to use any type of respiratory protection.

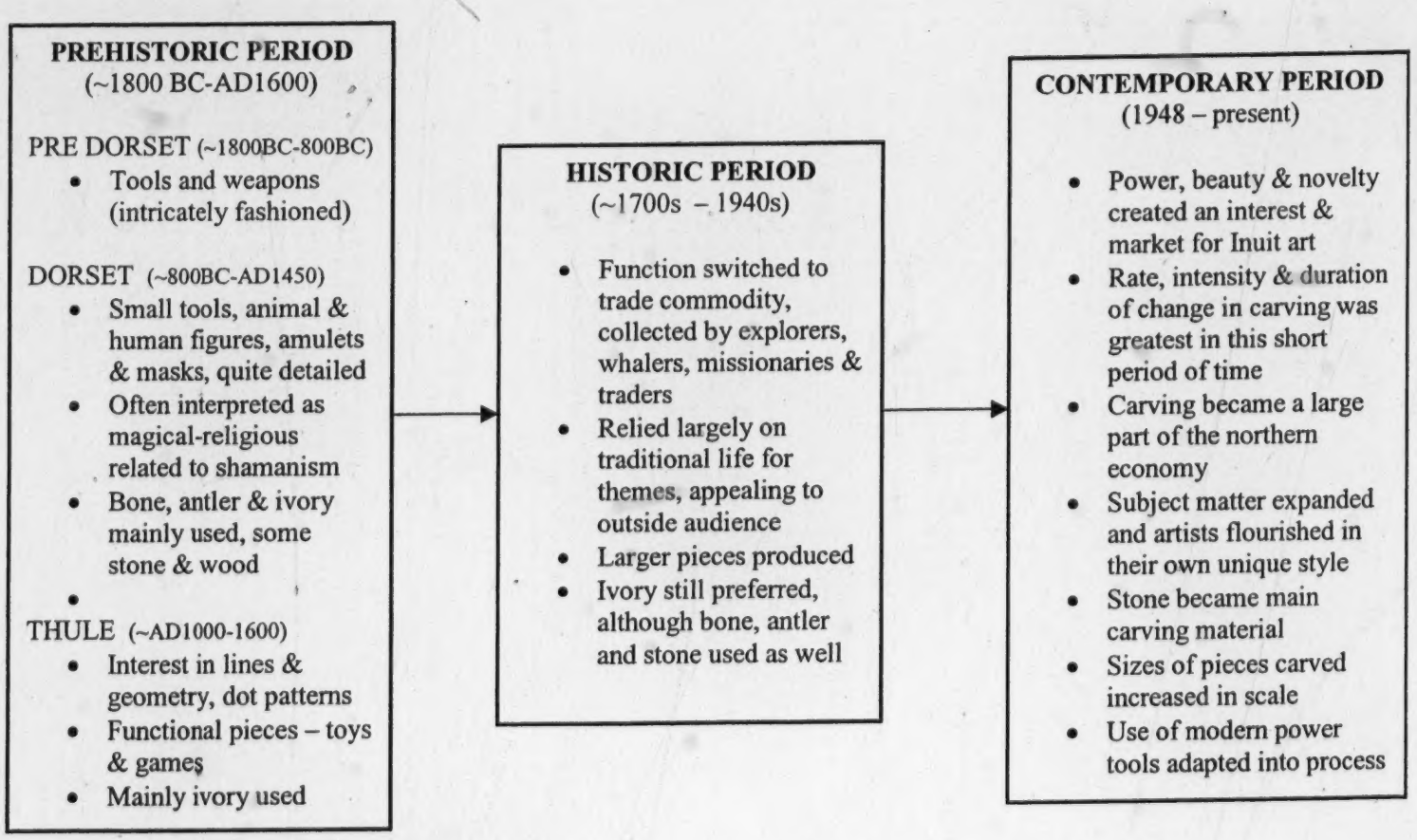
### 2.3.4 Risk Assessment

Risk parameters contributing to carver health hazards were characterized. They were:

- Inhalation exposure (BZ)
- Work place enclosure
- Power tool use
- Personal protective equipment (masks)
- Stone properties
- Work history
- Carver productivity

Risk factor (RF) values for each proposed parameter were assumed by setting the average carver at RF= 1.00. Among these, inhalation and work histories were found to be predominant. A risk prediction equation or model was proposed by combining these sub-factors into one formula by accumulation. The combined risk is the probability of any carver to have inhalation of soap stone dust exceeding 3 $mg/m^3$ (or EI > 100%) in a day's work. About 25% of carvers surveyed in four communities exceeded EI of 100% in one short time sampling.

Figure 2.1 History of Inuit carving


PREHISTORIC PERIOD
(~1800 BC-AD1600)
PRE DORSET (~1800BC-800BC)
• Tools and weapons (intricately fashioned)
DORSET (~800BC-AD1450)
• Small tools, animal & human figures, amulets & masks, quite detailed
• Often interpreted as magical-religious related to shamanism
• Bone, antler & ivory mainly used, some stone & wood
THULE (~AD1000-1600)
• Interest in lines & geometry, dot patterns
• Functional pieces – toys & games
• Mainly ivory used
HISTORIC PERIOD
(~1700s – 1940s)
• Function switched to trade commodity, collected by explorers, whalers, missionaries & traders
• Relied largely on traditional life for themes, appealing to outside audience
• Larger pieces produced
• Ivory still preferred, although bone, antler and stone used as well
CONTEMPORARY PERIOD
(1948 – present)
• Power, beauty & novelty created an interest & market for Inuit art
• Rate, intensity & duration of change in carving was greatest in this short period of time
• Carving became a large part of the northern economy
• Subject matter expanded and artists flourished in their own unique style
• Stone became main carving material
• Sizes of pieces carved increased in scale
• Use of modern power tools adapted into process

Adapted from: Crandall (2000) & Hessel (1998)

# CHAPTER 3: LITERATURE REVIEW

This chapter presents a review of published literature on respiratory disease from occupational, inorganic dust exposure. An introduction to occupational lung disease will be presented, including descriptions of dusts primarily discussed in the literature, and a summary of the prevalence of pneumoconiosis from several countries. Key studies of exposure in selected occupational fields that may bear resemblance to stone carving are discussed in relation to radiographic abnormalities, symptoms reported and lung function measurements. Finally, the influence of smoking in dust-exposed workers will briefly be discussed.

## 3.1 Occupational Lung Diseases and Inorganic Dust Exposure

Respiratory disease from dust exposure extends throughout time and has existed in both developed, and the developing regions of earth. The term "pneumonokoniosis" was introduced in 1866 by Zeneker to describe disease associated with exposure to mineral dusts. The term was subsequently shortened to pneumoconiosis.

Today, the term pneumoconiosis is defined as "an accumulation of dusts in the lung and the tissue reaction to its presence," by the International Labour Organization (1980). The term can be descriptive of either:

(a) the dust believed to be the causative agent; for example, silicosis and asbestosis, referring respectively to the pulmonary fibrosis which results from crystalline silica and asbestos; and (b) to describe the occupation at risk, for example, coal workers' pneumoconiosis.

The definition also allows that the tissue reaction to the presence of the dust may be collagenous (associated with scarring), or non-collagenous (associated with dust accumulation in the lung but minimal scarring) (Becklake 1992).

For mineral dust diseases, the industries mainly at risk include mining, milling, potteries, quarrying and stone work as well as abrasive workers (Wilt et al 1996). The main determinants of the distribution of the mineral dust diseases within workplaces are duration of

exposure, level of exposure, size of the particles, distribution and respirability of airborne particles and their fibrogenic potential (Becklake 1992, Lippmann 1990, Roggli 1990). Asbestos is a generic term applied to a number of metamorphic fibrous mineral silicates. It is generally accepted to include six minerals as asbestos, namely, chrysotile, crocidolite, amosite, anthophyllite, actinolite and tremolite.

All forms of asbestos belong to one of two distinct groups of minerals: the serpentine or amphibole group. Chrysotile is the only member of the serpentine group, the reminder are amphiboles. The various minerals can exist either as abestiform or nonabestiform habits (Ross et al 1988).

The effect of asbestos exposure results from the inhalation of these fibres, leading to a variety of possible outcomes such as asbestosis (interstitial fibrosis), benign pleural processes (plaques, effusion and diffuse fibrosis), as well as lung cancer and mesothelioma (Solomon 1989).

Silicon dioxide, or silica, is one of the most abundant materials in the earth's crust. The most common naturally occurring form of crystalline silica is quartz, a component of many rock types. This free silica occurs in a wide range of rocks, though it is not always the main component. For example, sandstone may contain up to 100%, and granite between 10% and 30%. Usually very low levels occur in the carbonate rocks, limestone, dolomite, or marble (Morgan and Seaton 1995). Silicosis is a disease characterized by nodular fibrosis of the lung. Silicosis includes a chronic form, an acute syndrome, or an accelerated form.

Talc is a member of the silicates group of minerals characterized by its structure in sheets that can be separated by slight forces. This causes the plate shape of the talc particles and the smoothness in touch (Rohl et al 1976). Soapstone is a less pure form of talc, and steatite is denser pure talc. Pure talc is far less fibrogenic than silica, and a much greater amount needs to be deposited in the lungs before fibrosis and radiographic abnormalities appear (Morgan and Seaton 1995).

Coal mining is linked to the history of the industrial development of nations. Coal provided fuel for factories, iron and steel production, and transport and also became the major source of domestic fuel. It exists on a spectrum from very hard, brittle black anthracite at one

extreme to crumbly brown lignite at the other (Morgan and Seaton 1995). The radiographic appearance of coal workers pneumoconiosis is similar to that of silicosis.

Manifestations associated with the inhalation, retention and tissue reaction to mineral dusts reflect the different properties and effects of these dusts on the lungs (Balaan et al 1993). However, all share common diagnostic criteria. There are three major criteria for the diagnosis of pneumoconiosis (adapted form Banks and Parker 1998):

1. Sufficient exposure to a mineral dust known to cause pneumoconiosis with an appropriate latency period,
2. Recognition of a characteristic chest radiograph which meets published standards for the diagnosis of pneumoconiosis,
3. The absence of an illness that might mimic pneumoconiosis

Radiographic changes generally have an average latency period of approximately twenty to thirty years, depending on type of dust and exposure level (Solomon 1989). Pneumoconiosis usually produces restrictive lung disease by causing small or restrictive lung volumes.

Although respiratory symptoms and impairment in lung function may occur in workers diagnosed with pneumoconiosis, neither is requisite for the diagnosis.

The respiratory diseases and disabilities, including pneumoconiosis, related to occupational exposures have been commonly recognized in both developed and developing countries (Banks et al 1993). Although cases of occupational lung disease are diminished by aggressive enforcement of regulatory policies, these measures are not often carried out in developing countries. Furthermore, inadequate record keeping prevents case ascertainment in many countries (Banks et al 1998).

Several prevalence studies of pneumoconiosis have been conducted around the world. Pneumoconiosis was reported to affect 15% of coal miners in Columbia (El Batawi 1978), and among 13, 000 Korean anthracite miners, the prevalence was 9.3% (Cho et al 1986). Among coal miners in Zimbabwe, chest radiographic changes consistent with pneumoconiosis rarely occurred before 15 years of exposure and the prevalence of pneumoconiosis among all miners was reported to be 20% (Baloyi and Cullen 1988). In a

study of Indian coal miners, there was a 12% prevalence of pneumoconiosis when studied after 16 years of exposure (Sinha 1988). In Brazil, pneumoconiosis was present in 5.6% of coal miners after a mean exposure of 8.4 years (Algranti et al1988), while among 3, 754 Chilean coal workers; the prevalence of pneumoconiosis was 14.1% (Benavides 1988). In China, it was reported that among all coal workers, the prevalence of pneumoconiosis was about 6% (Ministry of Public Health of the People's Republic of China 1992).

The Indian National Institute of Occupational Health performed environmental and medical surveys in several industries, investigating exposure to silica. For stonecutters, the prevalence of silicosis was found to be 22% (Kashyap 1994). In other studies of silica exposure, prevalence ranged from 3.48% in Chinese miners to 7.1% in Egyptian miners (El Batawi 1972).

Exposure to asbestos was extensively studied in Russia by Kagan et al (1983). Assessments of the dust levels collected over the past 40 years in asbestos industries have shown dramatic lowering of the asbestos levels. As a consequence, the number of new cases of asbestosis among exposed workers was reduced from 29% to less than 1%. In Thailand, the prevalence of asbestos or asbestos-related diseases in 1,013 workers employed in 24 factories was 5.2%. The mean age of the workers studied was 35 years, and the mean duration of exposure was 8.5 years (Metadilogkul et al 1988).

When lung function deficits are found in association with the pneumoconioses, they are commonly restrictive defects. However, in addition to pneumoconiosis, evidence exists that chronic airway disease, including airway obstruction, may be associated with exposure to environments contaminated by inorganic dusts (Becklake 1989).

The demonstration of such a relationship is complicated by the effects of cigarette smoking, which is known to cause airflow obstruction. Several studies among workers exposed to fibrous particulate in hard rock (Wiles and Faure 1975, Manfreda et al 1982) and talc (Wegman et al 1982) miners found airflow obstruction greater than that accounted for by cigarette smoking. In addition, pathology studies have documented that small airways disease is associated with exposure to mineral dusts, independently of any concurrent pneumoconic process (Cowie 1989; Churg et al 1985; Neuberger et al 1988).

A study by Copes et al (1985) added to the evidence that exposures to environments containing airborne inorganic dusts may result in either pneumoconiosis or other airway abnormalities. Using questionnaire, radiographic, and lung function information from 983 Quebec chrysotile workers, five clinical response scales were developed. The scales were specifically for parenchymal and pleural fibrosis, airflow limitation, chronic bronchitis, and airway reactivity. The approach involved regression analysis to determine the contribution of variables describing the exposure profile, after accounting for age and smoking. For pulmonary fibrosis, the strongest relationships were to cumulative dust exposure; for pleural fibrosis to exposure peaks and residence time of dust in the lung; for airway reactivity to early and recent dust exposure; and for airflow limitation and chronic bronchitis to smoking and dust level and load over time.

## 3.2 Key Studies

Although no studies have documented respiratory disease in arctic stone carvers, the literature does contain evidence of airflow limitation in occupations with relatively similar work processes and exposures, such as opencast mining, stone cutting, and milling.

The dust types in which the various occupational groups were exposed vary, and may have impacted the outcome under study. It should be noted that there are likely differences in the nature and particle size distribution of the airborne dusts in the various working environments. The findings from the studies are discussed below.

### 3.2.1 Community Prevalence Studies of Occupational Dust Exposures

Most information on airway response to occupational dust exposures has been a by-product of studies to quantitate pneumoconiosis in workforces. However, some strong evidence of occupational disease comes from community-based studies in which exposure was assessed not objectively (by industrial hygiene measurements) but subjectively (from questionnaire information as to exposure to dust and fumes at work) (Becklake 1989).

In earlier prevalence studies in mining communities, investigators showed that coal miners reported higher rates of chronic respiratory symptoms than did the general population, regardless of radiographic presence of pneumoconiosis (Higgins et al 1956; Higgins 1972).

In a cross-sectional study of 1200 men, approximately 50% had significant occupational exposures. Investigators found higher age and smoking adjusted prevalence of respiratory symptoms in subjects who reported high-intensity contact with silica, fibreglass, and automobile exhaust or who had worked in the construction industry (Lebowitz 1977).

A large study was conducted with a random sample of 8, 515 Caucasian adults in six US cities that examined the relationship between occupational exposure and chronic respiratory symptoms (Korn et al 1987). Of the participants, 31% had a history of occupational dust exposure. The types of dusts in which exposure occurred were not separated. After controlling for smoking habits, age, gender and city of residence, subjects with occupational exposure had significantly elevated prevalence of chronic cough (OR=1.32, 95% CI: 1.14-1.52), chronic phlegm (OR=1.42, 95% CI: 1.23-1.63), wheeze (OR=1.54, 95% CI: 1.29-1.84) and breathlessness (OR=1.60, 95% CI: 1.17-2.00).

Dust exposure was also associated with a higher prevalence of chronic obstructive pulmonary disease (COPD), as defined by a $FEV_1$/FVC ratio less than 0.6 (OR=1.53, 95% CI: 1.17-2.08). Significant trends were noted for wheeze and phlegm with increasing duration of dust exposure. Smoking was a significant independent predictor of symptoms, but did not appear to modify the effect of dust on symptom reporting.

### 3.2.2 Mining, Stone Crushing and Cutting

Mining is an industry in which the relationship between inorganic dust exposure and respiratory illness, has been extensively studied. This is particularly true for coal miners (Rogan et al 1973, Love et al 1997, Soutar and Hurley 1986, Marine et al 1988), and gold miners (Hnizdo 1990; Hessel et al 1986).

Stone crushing or cutting commonly includes quarries and processing facilities for crushing, sorting, and cleaning stone. Although some crushed stone is produced from underground

mines, most is obtained from open pit quarries (US Dept. of the Interior 1980). Activities may consist of overburden removal, drilling and blasting, secondary breakage by drop-ball or drop-hammer cranes, stone loading, and transport to a mill in which the stone is crushed, screened to size, and loaded for shipping. Airborne dust is generated during most or all of these procedures.

The prevalence of radiographic abnormalities associated with dust exposure in these industries is presented, followed by evidence of the non-specific respiratory morbidity attributable to dust exposure, namely symptoms and lung function.

***Radiographic Abnormalities***

Radiographic changes were observed in 6,131 men aged 36 to 65 years from Quebec chrysotile asbestos mines (Rossiter et al 1972). Investigators found the prevalence of abnormalities rose with increasing dust exposure. Small, irregular opacities were noted in 7.2% of miners, and 12.9% showed pleural changes. Similarly, in South African miners, Irwig et al (1979) noted a prevalence of 7.3% of small, irregular opacities and 7.6% showed pleural changes.

Investigations of lower levels of granite dust exposure leading to radiographic abnormalities were carried out by Graham et al (1991). A survey of the Vermont granite industry was undertaken, consisting of quarry and stone shed workers. The duration of observation encompasses up to 60 years of exposure to dust levels that, on average, had been in compliance with the current Occupational Safety and Health Administration (OSHA) standard for quartz exposure.

Of the films examined, 28 (3.0%) were interpreted as showing abnormalities consistent with pneumoconiosis. Only seven films (or 0.7%) showed nodular or rounded opacities of the type typically seen in uncomplicated silicosis. The remainder of the abnormalities showed irregular opacities, largely in the lower lung zones, which were of uncertain significance.

In another investigation of the Vermont granite industry, Graham et al (2001) demonstrated that reductions in dust exposure, by introduction of dust controls in 1940, were accompanied by a parallel reduction in prevalence of radiographic abnormalities. The percent of abnormal

radiographs among workers who received exposures before 1940 was much higher than among those who were hired after 1940 (25.9% vs. 5.7%, respectively).

Similar findings were noted in a British study examining opencast mining in order to identify evidence of pneumoconiosis and other respiratory health effects that are associated with respirable mixed dust and quartz (Love et al 1997). Of samples of dust taken, 99% of all quartz concentrations were below 0.4 mg/m$^3$. The prevalence of radiographic small opacities was 4.4%.

Airborne exposure to tremolite asbestos was confirmed in a study of dolomite workers in Sweden (Seldén et al 2001) however; the concentrations were generally below the limit of detection (<0.03 fibres/ml). Dolomite dust concentrations were moderate (median 2.8 mg/m$^3$). The investigators noted two cases of pleural plaques (1.5% of study group) that could not be attributed with confidence to exposure to tremolite asbestos in dolomite operations.

***Reported Symptoms***

The majority of symptoms reported in mining and stone cutting operations tend to be symptoms suggestive of chronic bronchitis (Morgan 1978).

Employees in an underground hard rock mining industry in Manitoba, in which approximately 20% of the respirable samples taken exceeded threshold limit values for silica, reported an increased prevalence of cough and phlegm (Muir et al 1989). This was reported by 38% of non-smokers, compared to 4% in the general population ($p<0.05$); 13% of ex-smokers, compared to 8% of the general population ($p>0.05$); and 51% of current smokers, compared to 36% of the general population ($p<0.05$).

In British opencast miners, Love et al (1997) found symptoms of chronic bronchitis were present in 13% of the men. Frequency of chronic bronchitis was influenced by years worked in dusty jobs. Asthmatic symptoms were reported by 5% of the workforce, close to the mean frequency found in adult men. No positive associations were found between asthma and occupational exposures.

Seldén et al (2001) examined the respiratory health in 130 Swedish dolomite workers. The most common symptoms reported were cough without phlegm and dyspnoea, with wheezing less often reported. The mean number of symptoms was less than one in the lowest two exposure categories (overall mean exposure to dust <5.0 and 5.0-9.9 mg/m³ respectively) and 2.1 in the highest category (> 10.0 mg/m³). However, in the logistic regression model with age and smoking, only smoking was significant for respiratory symptoms suggestive of bronchitis.

McDonald et al (1972) studied chrysotile asbestos mine workers and found little evidence of any association between cough, phlegm, and wheezing, and dust exposure, except perhaps in men over 50 years of age. The distribution of these symptoms showed an increasing prevalence with age and much higher rates in smokers than non-smokers or ex-smokers. However, breathlessness, though also more frequent with rising age, appeared more closely related to dust exposure than smoking. Similar findings were noted in British coal miners investigated by Rae et al (1971). In both surveys, smoking appeared to be the major determinant of bronchitic symptoms, and the effect of dust was only evident in non-smokers. Similar findings were also noted by Lloyd-Davies (1971) in a national survey of foundry workers in Britain. In a study of British coal miners (Marine et al 1988), investigators identified 543 lifetime non-smokers among 14,888 miners (3.6%) studied between 1953 and 1967 who were less than 65 years of age and did not have pneumoconiosis. Of these, 17% reported bronchitis.

***Lung Function***

In a systematic overview conducted by Oxman et al (1993), all studies included in the overview (10 studies on coal miners, 3 on gold miners) found a statistically significant association between loss of lung function and cumulative respirable dust exposure. It was estimated that 80 (95% CI 34-137) of 1,000 non-smoking coal miners could be expected to develop a clinically important (>20%) loss of $FEV_1$ attributable to dust. Among 1,000 smoking miners the estimate was 66 (95% CI 49-84). The risk of clinically important loss of lung function attributable to dust among non-smoking gold miners was estimated to be three times as large as for coal miners at less than one fifth the cumulative respirable dust exposure. Wiles and Faure (1975), in a longitudinal study involving 2,209 South African gold miners, found declines in $FEF_{25-75}$ and $FEV_1$ with increasing dust exposure in both smokers and non-smokers.

Wegman and colleagues (1982) showed, in a group of 103 workers mining talc, that $FEF_{25-75}$ decreased with increasing dust exposure, and the decreases in flow rates were greater than predicted from cigarette smoking alone. Wild et al (1995) also examined 166 talc millers from a French factory and studied the standardised residual values of lung function parameters. After adjustment for smoking, both FVC and $FEV_1$ decreased significantly with increasing exposure, this trend was not found for the $FEV_1$/FVC.

Soutar and Hurley (1986) studied current and ex-miners in Britain. When those with massive fibrosis were excluded, the average loss of $FEV_1$ due to moderately high dust exposures was 228 ml. Seldén et al (2001) found the mean forced vital capacity of Swedish dolomite workers was 211 ml lower than expected after adjusting for sex, age, height and smoking, but the decline in lung function was not associated with current or cumulative exposure in a clear-cut way.

Fournier-Massey and Becklake (1975), in a study of 1,000 Quebec chrysotile miners, found a 12.2% incidence of an obstructive profile of pulmonary function, an unusually high value that the investigators believed correlated with dust exposure. In a longitudinal study of a group of workers acutely exposed to asbestos dusts, Harless et al (1978) demonstrated the rapid development of airflow obstruction, with major abnormalities in the $FEF_{25-75}$.

However, demonstration of abnormalities in lung function has not been universal. In Britain opencast miners, Love et al (1997) noted lung function, on average, was close to predicted values and showed no relation to time worked in opencast occupations. Jain and Patrick (1981) also noted that the $FEV_1$ in Nigerian coal miners assessed cross-sectionally was no different than in the general population. Ziskind et al (1976) believed that symptom and function abnormalities correlated better with smoking history then they did with dust exposure, and Morgan and Seaton (1995) suggested that simple silicosis has little effect on lung function.

## 3.3 Smoking and Respiratory Health in Dust Exposed Populations

There are several commonly identified risk factors that can affect respiratory health such as age and smoking. Other possible factors that have been noted by researchers include gender (Greenberg and Dement 1994) host susceptibility (Burrows 1981, Abboud and Morton 1975), childhood illness (Myers et al 1984), environmental exposures (Speizer et al 1980), socio-economic status (Morgan 1978) and obesity (Lapp et al 1994). Of great interest and importance is the relationship between lung function and both cigarette smoking and dust exposure in exposed individuals who smoke.

Many studies have shown that the relationship of smoking to chronic lung disease appears to be quite strong and fairly consistent (Banks and Parker 1998; Stebbings 1971). Lebowitz (1982) investigated smoking and other risk factors for obstructive lung disease and related symptoms, in which multivariate analyses revealed several consistencies. Heavy smoking was related to cough and phlegm and often to wheeze. The linear discriminate function analysis appeared to indicate that pack-years of smoking contribute significantly to airway obstruction and respiratory symptoms. The investigation also confirmed age and gender as co-variables. However, it can be noted that there is a wide range of individual susceptibility to the effects of cigarette smoking, with just 10-15% of the smoking population severely affected (Fletcher et al 1974). Tager (1988), who studied the effects of cigarette smoking on respiratory conditions reported that among adults between the ages of 30 and 50 years, the decline in pulmonary function was only slightly greater for smokers than for non-smokers.

The question of interactions between occupational exposures and cigarette smoke in the development of lung disease is an important issue. Studies of the relationship between the effects of occupational exposures and smoking on airway abnormalities are inconsistent.

It has been proposed that the combination of dust exposure and cigarette smoke may act synergistically to produce functional impairment (Becklake 1989, 1985; Oxman et al 1993). In an investigation by Wright et al (1988), the combination of smoke plus dust produced synergistic decrements in some but not all flow parameters. An interesting finding by Kreiss et al (1989) on a group of hard-rock miners noted that those who did not smoke tended to develop restrictive disease patterns, whereas those who did smoke tended to develop

obstructive disease patterns, and the severity of the obstructive changes was greater than would have been accounted for by smoking alone, suggesting that synergism was present.

Other investigators have shown no modifications of the effects of dust by cigarette smoking (Weil et al 1975; Soutar and Hurley 1986). A cross-sectional study of 1197 working South African gold miners showed that simple silicosis was associated with significant loss of lung function. A greater percentage of the reduction in $FEV_1$ and $FEV_1$/FVC was attributed to the dust exposure than the amount of tobacco smoked [after 25 years in mining, workers averaged an $FEV_1$ loss of 172 ml due to smoking and 200 ml due to dust] (Cowie and Mabena 1991).

### 3.4 Summary

In occupations with mineral dust exposure, various prevalence studies of pneumoconiosis report prevalence from 1% to 22%, varying between countries and types of exposure.

Taking a more critical look at the literature concerning studies on mining, stone cutting and sculpting, reports of radiographic abnormalities reveal increasing prevalence with increasing dust exposure. In underground mines, the prevalence of abnormalities consistent with pneumoconiosis was on average 7%. In lower-level exposures of opencast operations where exposure levels are often in compliance with current standards, the prevalence of abnormalities ranged from 1.1% to 4.4%. Exposed workers commonly reported symptoms consistent with bronchitis (cough and phlegm) that generally tended to increase with years working in the occupation. The prevalence of reporting these symptoms generally ranged from 13% to 17%, but did reach as high as 51% in currently smoking miners. Breathlessness, or dyspnoea, was also reported frequently. Decreases in lung functions for dust-exposed workers were frequently noted and were often statistically associated with increases in dust exposure. However, parameters of lung function that were decreased were not consistent, nor noted consistently across studies.

Smoking was almost universally mentioned as an independent risk factor for respiratory symptoms and decreases in lung function, particularly expiratory flow rates. Reports on a potential interaction between smoking and dust exposure were found to be inconsistent.

# CHAPTER 4: METHODS AND MATERIALS

The purpose of this chapter is to describe the methods and materials used during this study in order to meet the outlined study objectives.

## 4.1 Study Objective

The overall goal of this study was to assess whether Inuit stone carvers have an increased prevalence of respiratory problems that may be related to their work. Through an examination of data collected from Inuit carvers and non-carvers within four communities of Nunavut, this study specifically addressed the following objectives:

1) Describe the carving practices, living environment, and respiratory health of adult Inuit living in the Eastern Arctic;
2) Determine the prevalence of respiratory symptoms, radiographic evidence of pneumoconiosis as well as lung volumes and expiratory flow rates in carvers and non-carvers;
3) Examine the extent to which differences in carving practices, demographic factors, personal habits and other factors accurately predict the presence of respiratory symptoms, and differences in lung volumes and expiratory flow rates.

## 4.2 Study Design

The study was cross-sectional with three components:

1) A questionnaire to examine personal characteristics and habits, respiratory symptoms, health status and history, home environment, and occupational exposures (including carving);
2) Spirometry testing. Spirometry is a test that measures the volume of air an individual inhales or exhales as a function of time (ATS 1994);
3) Chest radiographs to examine abnormalities consistent with pneumoconiosis.

Cross-sectional studies are essentially a "snapshot", examining a cross-section of a population at one point in time (Daly et al 2000). This type of study can be employed to study associations between diseases/conditions and other factors, but presents difficulty in determining which might have occurred first. This type of study is ideally suited for studying the prevalence of a disease, which can be defined as "the proportion of persons in a population who have the illness in question at a particular point in time." (Daly et al 2000). Cross-sectional studies are also useful for estimating community needs, attitudes or behaviours.

### 4.3 Sampling and Recruitment of Participants

The four communities were selected on the basis of the results of the feasibility study (Green et al 1992). It was anticipated that the mineralogy of the carving stones would be different in the regions of Baker Lake, Gjoa Haven, Taloyoak, and Cape Dorset. The individual communities were selected due to the large number of resident carvers.

Lists of Inuit artists are compiled by the Canadian Inuit Art Information Centre, Department of Indian Affairs and Northern Development. The September 1996 version of this listing was used to compile lists of carvers in the selected communities for the current study.
For a comparison group (non-carvers), voters' lists were obtained from each participating community. Individuals were randomly selected and frequency matched by gender to the carving group. In three of the communities, random samples of non-carvers were frequency matched to the carvers by gender. In the fourth community (Cape Dorset), there was difficulty in matching the number of male carvers with non-carvers; therefore, all non-carving residents over the age of 35 were invited to participate. This accounts for the difference of gender distribution between the carving and non-carving groups within this community.

Within each community, a knowledgeable individual reviewed the list and made additions (carvers that were missed, possibly moved into the community recently) or deletions (those who had died or moved out of the community).

Data collection took place between February and April 2001.

## 4.4 Inclusion and Exclusion Criteria

The term stone carver applies to a variety of individuals in the Eastern Arctic. For the purpose of this study a carver was defined as:

1) Age 35 years and over;
2) Carved for at least one year (could be retired); and
3) Produced stone carvings for sale.
4) Of Inuit (Inuk) descent.

The minimum age of 35 was selected due to the latency period of certain diseases of interest, such as asbestosis, which has an average latency period of 20 years (Morgan and Seaton 1995). Individuals selling sculptures and who had carved consistently for one year or more were likely to represent an occupational carving group. Those for whom carving was an avocation, or a recreational activity, would not be included in the classification.

Non-carvers were defined as:

1) Age 35 years and over;
2) Never carved or sold sculptures for one year or more; and
3) Of Inuit (Inuk) descent.

## 4.5 Sample Size

Sample size was calculated, assuming equal number of carvers and non-carvers. Testing of 428 carvers and 428 non-carvers would have provided the ability to detect the following differences between groups (with 80% power and 95% confidence):

| | Estimated (non-carvers) | Detectable among carvers |
|---|---|---|
| Small opacities (x-ray) | 3.0% | 7.5% |
| Usual phlegm | 9.0% | 15.5% |
| $FEV_1$ | 3,214 ml | 65 ml difference |

These conditions were selected because they are among the primary outcomes of interest. This sample size would be adequate to determine meaningful differences if they exist.

## 4.6 Data Collection

### 4.6.1 Questionnaires

Trained individuals conducted the interviews under the guidance of a field manager. Interviewers were fluent in English, and the local language, Inuktitut. The majority of questionnaires were done in the participant's home, but may also have been completed in an alternate location. The language used during the interview was generally Inuktitut, however all responses were recorded in English.

Personal characteristics, respiratory symptoms, illnesses, personal habits, family history, home environment, and occupational exposures were documented using the American Thoracic Society questionnaire (Ferris 1978). Questions related to carving exposure and practices were added (Appendix B). The field manager reviewed all completed questionnaires.

### 4.6.2 Spirometry

Spirometry was conducted with Medical Graphics Corporation (2000) SpiroCard PC Card Spirometer with disposable pneumotachs, and Office Medic Software (version 1.06), which fulfill the criteria of the American Thoracic Society (ATS 1987). Equipment was calibrated at least once per day. At least five acceptable forced expiratory manoeuvres were attempted with all subjects in a seated position. Lung function measurements were automatically calculated and corrected to BTPS. Nose plugs were not used, as they were not appropriate for the facial structure of the Inuit. All subjects pinched their noses during manoeuvres. Height and weight measurements were taken at the time of testing in light indoor clothing, without shoes.

### 4.6.3 Chest Radiographs

Recent chest radiographs, taken within the past two years (1999-2001), were sought for all participants. Many radiographs were available on file in the respective health centres. For those not on file, an x-ray was taken at the health centre by local staff. For Cape Dorset, the vast majority of x-rays was duplicated from those on file at Baffin Regional Hospital, Iqaluit.

## 4.7 Data Management

### 4.7.1 Questionnaires

Data from the questionnaires were coded and checked for missing information. Missing or unclear information was checked with participants through a designated contact individual within each community, and confirmed via facsimile. Data were double entered and checked using dBase IV. The file was transferred into SPSS, version 10.0 (SPSS 1999) for analysis.

### 4.7.2 Spirometry

Spirometry test results were read by two individuals and checked for acceptability and reproducibility, based the criteria of the American Thoracic Society. A summary of acceptability and reproducibility criteria are presented below (see Appendix C for more detail):

*Acceptability:*

1) satisfactory start of test;
2) minimum FVC exhalation time of 6 seconds; and
3) satisfactory end of test.

*Reproducibly:*

1) the largest FVC and second largest FVC from acceptable manoeuvres must not vary by more than 0.2 L; and
2) the largest $FEV_1$ and the second largest $FEV_1$ must not vary by more than 0.2 L.

Any current health conditions were noted at the time of testing and coded. The largest FVC and the largest $FEV_1$ were recorded after examining the data from all of the acceptable curves, even if they did not come from the same curve. Other lung function measures, such as the $FEF_{25-75}$ were obtained from the acceptable curve that gave the largest sum of FVC plus $FEV_1$ (best test).

Spirometry data were double entered and checked using dBase IV. The file was converted into SPSS (version 10.0) for analysis, and merged with the questionnaire data.

### 4.7.3 Chest Radiographs

Radiographs were forwarded to two readers for interpretation. The readers were blind to the carving status of the participants. A third reader read only films in which the two primary readers disagreed. When the three readers noted any abnormalities, a median score was entered for analysis.

Interpretations were recorded on a standard roetgenographic interpretation form from the Department of Health and Human Services, Public Health Service, Centres for Disease Control (OMB No. 68-5 1322).

Data from the forms were coded, double entered and checked using dBase IV. The file was then transferred to SPSS (version 10.0) for analysis. Comments were entered into a database in Microsoft Access. Any questions regarding comments on the forms were checked with the appropriate reader for clarification.

The technical quality of the radiographs was graded as follows (ILO 1980):

1) Good.
2) Acceptable – no technical flaw that would impair classification
3) Poor – film with defects, but still classifiable.
4) Unacceptable.

Films labelled unacceptable by either of the primary readers were not used in the statistical analyses.

### 4.8 Data Analysis

#### 4.8.1 Descriptive Analysis

The study population was described with respect to personal characteristics, tobacco use, past illnesses, home environment, occupational exposures and carving practices, if applicable.

Results of the descriptive analysis can be found in chapter 5.

#### 4.8.2 Respiratory Symptoms

*Symptoms of Interest (outcome variables):*

**Cough:** Cough is a sudden and explosive forcing of air through the glottis to expel mucous and other material from the tracheal-bronchial tree (Glauser 1983). A cough that is dry or productive of mucoid sputum can be seen in a variety of occupational lung diseases. Questions concerning both usual and chronic cough were asked of the participants. Chronic cough was defined as coughing most days for $\geq 3$ consecutive months, for $\geq 2$ years.

**Phlegm:** Phlegm refers to lung and tracheobronchial tree secretions. During acute and chronic inflammation and irritation or in certain pathological states, the volume of phlegm may increase due to excessive production of mucous and serous secretions (Glauser 1983).

Questions concerning both usual and chronic phlegm were asked of the participants. Chronic phlegm was defined as producing phlegm most days for $\geq 3$ consecutive months, for $\geq 2$ years.

**Shortness of breath:** Also known as dyspnoea, shortness of breath is a subjective feeling of difficult, uncomfortable, or unpleasant breathing. It is an awareness of the need for increased respiratory effort. Dyspnoea is one of the most common symptoms of respiratory diseases and is considered a good marker of respiratory illness (Nejjari et al 1993). In the questionnaire, shortness of breath was defined according to the following question: "Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill?"

**Chest tightness**: Chest tightness can be either pleuritic or nonpleuritic. Pleuritic chest tightness is usually located posteriorly or laterally, is sharp and stabbing in nature, and is worsened by deep breathing and coughing. Participants were questioned as to ever having their chest feel tight.

**Wheeze**: A wheeze is an abnormally high-pitched sound produced by breathing through partially obstructed or narrowed airways. Several questions concerning wheezing were of interest, including wheezing without a cold during the prior twelve months, attacks of wheeze including shortness of breath, and wheezing accompanied by chest tightness.

*Bivariate Analysis:*

Bivariate analyses were conducted on the presence or absence of selected symptoms reported, in relation to selected variables. In addition to carving status, the selected variables were tested to identify significant associations with the respective symptom (outcome). Findings were used to identify significant variables for entry into the multivariate analysis and to identify risk factors potentially amenable to intervention.

The significance of the association between the outcomes and nominal variables was evaluated using Pearson's chi-square test statistic. If the categorical variable was ordinal, the variable was evaluated using chi-square for linear trend. Associations between the outcomes

and continuous variables were tested using the independent t-test statistic. Associations were considered statistically significant if the corresponding p-value was less than 0.05 (2-sided).

*Multivariate Analysis*:

The goal of multivariate analysis was to find the best fitting and most parsimonious, yet biologically reasonable model to describe the relationship between respiratory symptoms and a set of independent variables (Hosmer and Lemeshow 1989).

Logistic regression analyses were carried out for each symptom of interest. Logistic regression is a mathematical modelling approach that can be used to describe the relationship of several predictor variables to a dichotomous dependent variable, such as presence or absence of a symptom. This method of analysis uses an iterative procedure whereby the answer is obtained by several repeated cycles of calculations using an approach known as maximum likelihood (Kleinbaum et al 1998). The logit form of the equation is:

$$\text{Logit}\,[\text{pr}(Y=1)] = \beta 0 + \sum_{j=1}^{k} \beta_j X_j$$

In order to use logistic regression, certain assumptions must be satisfied. Assumptions for logistic regression were checked for the analyses, specifically:

1) Independence: The response of one case cannot depend on the response of another case.
2) Linearity: Continuous variables must demonstrate significant linear relationship with the dependent variable. Linearity of continuous variables is tested using logit plots. Variables are divided into categories based on quartiles. A logistic regression analysis is run with the independent variable in its quartile form and the outcome variable (i.e. symptom). The resulting β values are then plotted against the midpoint of each quartile for the independent variable. By examining this plot, an assessment is made as to whether a non-linear relationship exists between the independent variable and the outcome variable (symptom of interest).
3) Multicollinearity: two independent variables with a high correlation results in the two variables having virtually indistinguishable associations with the outcome

variable. To test for multicollinearity for continuous variables, the correlation coefficients between the pairs of variables were examined. For degree of association between categorical independent variables, the cross-tabular odds ratios were investigated. Variables cannot have missing cases.

4) No complete separation of variables.

To obtain the most parsimonious model for each outcome of interest, a backward elimination procedure was used. This process involved four steps (adapted from Kleinbaum et al 1998):

1) A regression equation was determined containing all selected independent variables.
2) A partial F statistic was determined for every variable in the model as though it were the last variable to enter, and the p-values associated with the test statistic.
3) The largest observed partial F statistic (highest p-value) was documented.
4) The p-value was compared with a selected significance level (20%), and considered for removal. If the variable was dropped, the regression equation was recomputed for the remaining variables, and steps 2, 3 and 4 were repeated. If the variable was not dropped, the backward elimination procedure ended, and the selected model consisted of the variables remaining in the model.

Variables that were considered biologically relevant, and the variable under study were forced into the model. These variables were the age, gender, cigarette pack-years, community of residence and carving status.

To demonstrate that the model chosen was reasonable for the data, the goodness of fit of the final models was assessed using Hosmer-Lemshow's goodness of fit test (Hosmer and Lemeshow 1989). This test groups the predictions of a logistic regression model rather than the model's predictor variable data. Model predictions are split into G groups (G=10 default value) that are filled as evenly as possible. The differences between the expected and observed proportions are evaluated using the test statistic. The Hosmer-Lemeshow statistic follows a chi-square distribution with G-2 degrees of freedom. If the test statistic was significant, the expected and observed proportions differed significantly from one another and the model would not have been a good fit.

Logistic regression analyses were performed in three steps to investigate the contribution of the following variables to the outcomes of interest:

1) Carvers were compared to non-carvers;
2) The carvers were classified in two groups according to the type of media used for carving (stone only or stone + organic materials);
3) The carvers were classified into groups according to exposure level (number of pieces carved and years carving);

Results for the analysis on symptoms can be found in chapter 6.

### 4.8.3 Lung Function

*Parameters of Interest (outcome variables):*

**Forced Vital Capacity (FVC):** the volume of air that can be exhaled forcefully from the lungs after a maximum inspiration, expressed in litres. In individuals with airflow obstruction, or a restrictive process it is common to see a reduced FVC.

**Forced Expiratory Volume in one second ($FEV_1$):** the volume of air exhaled in the first second of the FVC manoeuvre, expressed in litres. The $FEV_1$ is used primarily as an indicator of airflow obstruction and in the assessment of breathlessness on exertion (Cotes et al 1997).

**$FEV_1$/FVC:** the $FEV_1$/FVC ratio (usually multiplied by 100 and expressed as a percent) is the primary variable used to determine the presence of airflow limitation (Wanger 1996). In patients with airflow obstruction, the ratio is reduced.

**$FEF_{25-75}$:** the mean forced expiratory flow during the middle half of the FVC, expressed in litres/second. Many clinicians believe that it comes from a part of the spirogram that is relatively effort independent and that it describes the status of the small airways, which are

thought to reflect early airway obstruction. However, the $FEF_{25-75}$ is highly variable from trial to trial in the same patient, and it depends heavily on the size of the FVC (Wanger 1996).

*Descriptive Analysis:*

Descriptive results from those participating in spirometry were examined, stratifying by age groups. Physical stature, lung volumes and selected flow rates are presented.

*Percent of Predicted:*

Reference equations are used in spirometry to determine the normal range of results in a pulmonary function test, usually on the basis of tests in a reference population. Race has been shown to be an important determinant of lung function (ATS 1991). When compared with Caucasians of European decent, values for most other races usually show smaller static and dynamic lung volumes and lower forced expiratory flow rates but similar or higher $FEV_1$/FVC ratios (ATS 1991).

Parameters of interest are presented as percent of predicted for the Inuit group in total, as well as for carvers and non-carvers, based on reference values from Crapo (1981).

*Bivariate Analysis:*

Bivariate analyses were conducted on the spirometric parameters of interest, in relation to selected variables. Findings were used to identify significant variables for entry into the multivariate analysis.

Differences between the means of spirometric parameters (continuous variables) for dichotomous variables of interest were tested using the independent t-test statistic. For categorical variables with 3 or more levels, associations were tested using one-way analysis of variance. Associations were considered statistically significant if the corresponding p-value was less than 0.05 (2-sided).

*Multivariate Analysis:*

For analyzing the continuous variables in the lung function table, analysis of covariance (ANCOVA) was performed. This technique involves a multiple regression model in which the study factors of interest are all treated as nominal variables, whereas the variables being controlled may be measurements on any measurement scale (Kleinbaum et al 1998). Under this model, the adjusted mean scores for the outcome groups of interest are defined to be the predicted values obtained by evaluating the model when the continuous variables entered as covariates are set equal to the overall mean of that covariate for the two outcome groups. A partial F test is then used to determine whether these adjusted mean scores are significantly different.

In this approach, a regression model is fit using the following formula, where Y is the independent variable, X is referred to as the covariate and Z is a dummy variable that indexes two groups to be compared:

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + E$$

As with all regression approaches, certain assumptions exist in order to use analysis of covariance. These assumptions are (adapted from Kleinbaum et al 1998), where Y represents the dependent variable and $X_k$, the independent variables:

1) Independence: The Y observations are statistically independent of one another.
2) Linearity: The mean value of Y for each specific combination of $X_1, X_2 \ldots\ldots, X_k$ is a linear function of $X_1, X_2 \ldots\ldots, X_k$.
3) Homoscedasticity: The variance of Y is the same for any fixed combination of $X_1, X_2 \ldots\ldots, X_k$.
4) Normality: For any fixed combination of $X_1, X_2 \ldots\ldots, X_k$, the variable Y is normally distributed.
5) Parallelism: there is no interaction between covariates and study variables.

Adjusted, estimated means and confidence intervals were generated for spirometric parameters of interest in three steps:

1) Carvers compared to non-carvers;
2) The carvers were classified in two groups according to the type of media used for carving (stone only or stone + organic materials);
3) The carvers were classified into groups according to exposure level (number of pieces carved and years carving).

Results for the analyses on lung function can be found in chapter 7.

### 4.8.4 Chest Radiographs

*Technical Quality:*

The overall quality of the radiographs used will be discussed with reference to the grade (1-4) given by the readers.

*Parameters of Interest for Pneumoconiosis:*

**Parenchymal Abnormalities**: Nodules appear in the lung fields of a chest radiograph as small discrete opacities, rounded and/or irregular in shape, a few millimetres in diameter, and distributed widely throughout the lungs. Under the ILO classification system (1980), the following four characteristics are recorded for small opacities:

1) Shape: rounded and/or irregular;
2) Size: classified according to the approximate diameter of the predominant lesions;
3) Profusion: refers to the concentration or number of small opacities per unit area, measured on a 12-point scale;
4) Extent: Spatial distribution of opacities (six lung zones described).

With continued exposure, the opacities will increase in number until ultimately, adjacent lesions coalesce to form large opacities several centimetres in diameter. Under the ILO classification system (1980), large opacities (greater then 10 mm in diameter) are coded in one of three size categories.

**Pleural Abnormalities:** Some fibres tend to migrate to pleural surfaces and create localized fibrous thickening of pleural tissues. These lesions characteristically occur along lower chest walls, on diaphragmatic surfaces, an in pleural and pericardial surfaces adjacent to the heart. Frequently, they become calcified (Solomon 1989). Under the ILO classification (1980), the following characteristics are recorded for pleural thickening:

1) Site: diaphragm, costophrenic angle, and chest wall (circumscribed or diffuse, left or right chest wall);
2) Width: three categories;
3) Extent: defined by maximum length of pleural involvement (three categories).

For pleural calcification, the following two characteristics are recorded:

1) Site: chest wall (right or left), diaphragm (right or left), and other (includes pericardial and mediastinal pleura);
2) Extent: three categories.

*Inter-rater Agreement:*

Guidelines of the Epidemiology Standardisation Project of the American Thoracic Society propose that at least two readers should interpret films and that inter-rater variability should be examined (Ferris 1978). As only two of the three readers in this study examined all of the radiographs, a frequency table showed the agreement between the two readers in terms of the outcomes of interest.

A Kappa test was run to assess inter-rater agreement. Kappa ($\kappa$) is a measure of agreement between two readers. Kappa is a ratio: the numerator is the observed improvement over chance agreement, and the denominator is the maximum possible improvement over chance

agreement (Jekel et al 1996). Thus, the kappa ratio is a proportion that can go from –1 (indicating perfect disagreement), through 0 (representing the agreement by chance) to +1 (indicating perfect agreement).

*Descriptive Analysis:*

The outcomes of interest (parenchymal and pleural abnormalities) were described on a case-by-case basis. For a case to be described, two of the three readers must have reached agreement on the outcome of interest. Cases were described using the following variables: outcome, gender, age, tobacco use, community of residence, history of tuberculosis, occupational exposures, and carving exposure (if yes, for how many years and number of pieces carved).

Results for the analyses on chest radiographs can be found in chapter 8.

## 4.9 Ethical Considerations

Ethics approval was obtained from the Health Ethics Review Board at the University of Alberta. A research license was obtained from the Nunavut Research Institute in Iqaluit.

The lead investigator, and the head field researcher, undertook a visit to the participating communities three months prior to the start of the field investigation. This allowed the communities to become aware of the study. Meetings were held with employees of each health centre and community leaders to discuss logistics and obtain advice.

Individuals selected for the study were approached and given full details of the investigation (Appendix D). Signed, informed consent was obtained for each participant (Appendix E). All information and consent forms were made available in English and Inuktitut.

During examination of chest radiographs, a reader may have noted abnormalities that required the participants' physicians being notified, such as potential tumours. In this case, a letter was sent from a designated reader explaining the potential findings to the respective health centres.

### 4.10 Dissemination

This is a community-based project, and as such, efforts were made to keep the participating communities, stakeholders and other interested parties informed and up to date. Following initial data collection and analysis of questionnaires, a newsletter was created for the purpose of dissemination. This newsletter can be found in Appendix F.

Upon completion of all analyses, feedback from all project members, community representatives and the health region, will be used to identify the most appropriate methods to disseminate findings to the communities.

# CHAPTER 5: DESCRIPTIVE RESULTS

The purpose of this chapter is to provide an overall descriptive analysis of the study population. Results are presented and compared for carvers and non-carvers in order to determine whether variables examined were similar between groups.

## 5.1 Study Participation

Figure 5.1 depicts the flow of participants in all components of the study. There were 673 individuals identified for participation. When checked during fieldwork in the communities, this number was reduced to 559. This reduction resulted from:

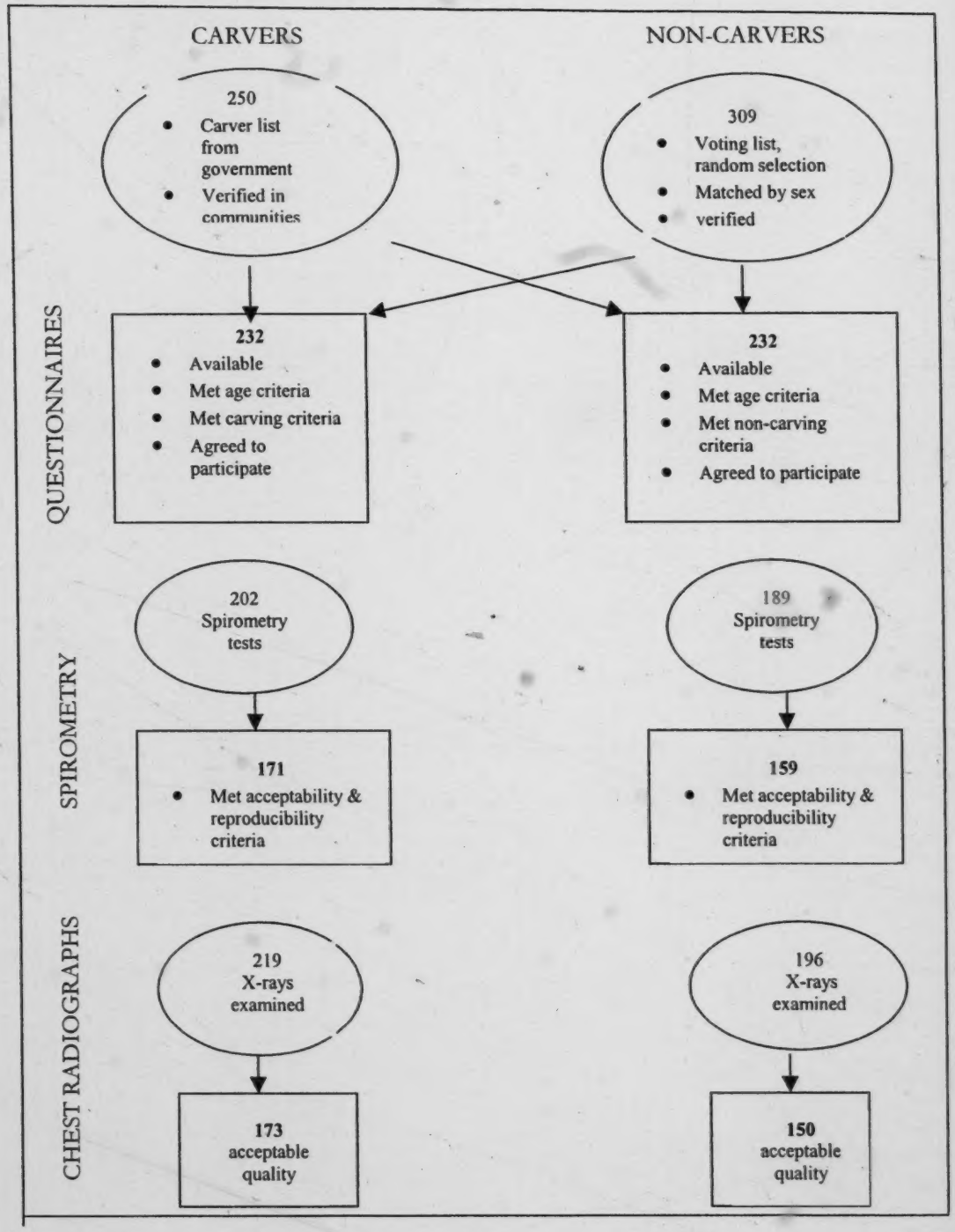
1) Migration or death,
2) Not being of Inuit descent,
3) Not reaching the age of 35.

Of those available and able to participate, the response rate for completing the questionnaire was 83% (n=464 individuals). Carvers represented 50% (n=232) of the participants, and non-carvers 50% (n=232). Of those refusing participation, 79% did not provide a reason, 15% were uncooperative or did not show up to scheduled appointments, 4% were too ill to participate, 1% was unable to understand the dialect, and 1% wanted money for participation.

Of the 464 participants completing the questionnaire, 84% (n=391) participated in the lung function testing. Carvers represented 52% (n=202) and non-carvers 48% (n=189). Of those not participating in spirometry, 39% did not provide a reason, 16% were uncooperative, or did not show up to scheduled appointments, 16% were unavailable, 14% had health concerns, 10% had a physical disability, and 5% stated mental/emotional difficulties as a reason for not participating.

Chest radiographs were obtained for 89.4% (n=415) of the participants who completed the questionnaires. All radiographs were recent, taken on or after 1999. Many radiographs were available on file at the respective health centres or from the Baffin Regional Hospital in Iqaluit.

Figure 5.1. Study participation



## 5.2 Demographic Information

Table 5.1 lists demographic information of participants in the study by carving status. Carvers had a mean age of 54.0 years (range: 35-84 years), which was slightly older than the non-carving group, with a mean age of 50.1 years (range: 35-88 years).

The carving group had more males (70.3%) than females (29.7%), whereas the non-carving group was comprised of 44.0% males and 56.0% females. The four communities had different population sizes and constituted variable numbers of study participants. In Baker Lake, the largest of the communities (population 1,453), 124 individuals participated, making up 26.7% of the study population. Gjoa Haven (population of 957) represented 14.2% (n=66) of the study population. Taloyoak, also smaller (population 729), represented 14.0% (n=65) of the study population. Residents of Cape Dorset (population 1,188) represented 45.1% (n=209) of the study population.

The majority of carvers and non-carvers were either in a married or common-law relationship (67.9% total). Of the remaining carvers, 12.5% were single and 14.2% were widowed. Of the non-carvers, 17.2% were single and 9.1% were widowed.

Participants were asked about the highest level of education obtained. The responses included only the education obtained in an institution. Education received through family and elders was not included. Of the carvers, 41.5% reported no formal education whereas 2.6% reported having graduating from high school. Of the non-carvers, 26.3% reported no formal education and 5.6% reported graduating from high school.

## 5.3 Tobacco Use

Table 5.2 presents cigarette-smoking characteristics of carvers and non-carvers. The prevalence of cigarette smoking was high in this study population. Of all participants, 91.8% had smoked cigarettes at some point in their life. Of the carvers, 58.2% were current smokers, 37.5% were ex-smokers, and 4.3% reported being non-smokers. Of the non-carvers, 65.5% reported being current smokers, 22.4% ex-smokers, and 12.1% non-smokers.

To examine the cumulative exposure to cigarette smoke, cigarette pack years were calculated using the following formula:

$$\text{Cigarette pack years} = \frac{(\text{average \#cigarettes smoked daily})\ (\text{\# years smoked})}{20}$$

Carvers reported an average of 21.4 pack years (SD 21.3). Non-carvers reported an average of 14.8 pack years (SD 13.9).

Both carvers and non-carvers had been commonly exposed to second-hand smoke. In the total study population, 90.6% reported that their father had smoked and 84.9% reported their mother had smoked. In addition, 54.9% stated they had a spouse who smoked, and 64.6% reported an additional member in their household smoked cigarettes.

In contrast to high rates of cigarette smoking, use of pipes and cigars was low for both carvers and non-carvers. Table 5.3 presents characteristics of tobacco use other than cigarettes. 81.0% of carvers and 91.1% of non-carvers had never smoked a pipe. Currently, only 1.3% of carvers and 0.9% of non-carvers smoked a pipe. Reported smoking of cigars was low with 92.6% of carvers and 98.3% of non-carvers having never smoked a cigar. No carvers and one non-carver smoked cigars.

## 5.4 Past Illnesses and Allergies Reported

Participants were asked about previous respiratory illness (table 5.4). Medical records were not available to check the accuracy of the statements.
In the present study, 25.9% of carvers and 18.1% of non-carvers reported lung trouble before the age of 16. 9.9% of carvers and 7.3% of non-carvers reported bronchitis. Current, physician diagnosed asthma was reported by 8.2% of carvers and 7.3% of non-carvers. History of tuberculosis was reported more often by carvers (39.7%) than in non-carvers (29.3%).

Allergic symptoms from exposure to various stimuli were not common in the study population (table 5.3.2). When exposed to animals, dusts and feathers, 8.4% of all participants reported coughing from exposure, 5.0% wheezing, and 8.6% a runny or stuffy nose. Symptoms resulting from exposure to grass, plants, flowers and pollen were also uncommon. Only 1.3% of all participants reported a cough when exposed, 0.9% wheeze and 1.7% a runny or stuffy nose.

## 5.5 Home Environment

Little if any difference existed in the home environment between carvers and non-carvers (table 5.6). Of all the participants, the mean years living in their community was 39.2 (range 2-88 years). The mean years living in their current home was 8.7 (range 6 months-88 years). The majority of participants lived in a single-family home (73.3%), built after 1981 (61.1%).

Heating and hot water were predominantly provided by an oil-fired boiler (91.5%) and electric stoves were used by the majority of participants (99.6%). Generally, stoves had a fan present over the cooker (94.8%), of which 86.3% took cooking fumes outside.

Of the total participants, 13.4% reported having had mould present in their homes and 19.9% reported having had water damage. Use of humidifiers was similar between carvers and non-carvers, with 32.2% of the total study population reporting some use.

## 5.6 Occupational Exposures

Participants were asked a series of questions concerning their past and present occupations. Specifically, they were questioned whether or not they had ever worked in a job that exposed them to vapours, gas, dust or fumes. Table 5.7 lists the industries where occupational exposures had occurred. Responses were similar between the carvers and non-carvers.

More males (n=127) than females (n=27) reported occupational exposures, particularly men in the 35-45 years age range. For the carvers, 28.9% responded that they had been exposed in one job, 2.6% in two jobs and 0.9% in three jobs. For non-carvers, 20.7% had been exposed

in one job, 2.6% in two jobs and 0.4% in three jobs. For all participants, the average years of exposure for their first job was 6.5 years.

For all participants stating exposure (n=154 jobs), the housing industry was recorded most often (22.4%), followed by mining (13.4%) and administration/office work (10.4%).

Table 5.8 lists the types of exposures reported. All were comparable for carvers and non-carvers. For the dust category, all participants responding with exposures (n=199) listed "general dust" most frequently (23.1%), followed by drywall (6.0%) and wood (6.0%). Within the fumes category, 23.9% responded with paint most frequently, followed by fuel (14.2%) and diesel (11.9%). Within the chemical category, cleaning products were listed most frequently (9.7%), followed by printing chemicals (3.0%).

A small number of respondents (2.2%, n=10) had left or changed a job due to breathing difficulties. Table 5.9 lists the various occupations stated. Of the carvers, three individuals had left a job in mining, whereas two non-carvers left a job in manufacturing.

## 5.7 Carving Practices

Carving practices varied between artists. For the 232 carvers in the present study, questions were asked concerning carving production, materials used, when and where carving was done, if masks were used and injuries incurred during carving. Tables 5.10 – 5.13 present these practices by community of residence; however, practices for the total number of carvers (n=232) are discussed in this section.

Artists had been carving for an average of 17.8 years (range 1-67 years). The number of carvings produced over a carvers' lifetime varied between 2 and 20,000 pieces (mean =1421.1, median=200). The sizes of these carvings were also variable. Most carvers produce a variety of sized carvings (50%), whereas 27.6% mainly carve small pieces, 21.1% medium and 4.3% of carvers focused on large pieces. In addition to carving with stone, 34.9% had used ivory, 60.8% antler, and 37.5% bone. The amount and extent that these organic materials were used was not documented (table 5.10).

Dust masks were used by 57.8% of carvers, however, not all consistently (table 5.12). Of those using masks, 28.4% reported always using them, 20.9% reported "most of the time", 34.3% reported "sometimes," and 16.4% "not often." Of those using masks (n=134), 46.3% reported having problems with their masks occasionally freezing.

Participants were asked about injuries incurred while carving (table 5.13). Of the 232 carvers, 19.0% reported an eye injury, 13.6% of whom received permanent eye damage. Hand or arm infections were reported by 10.4% of the artists. Cuts were reported by 33.3% of the artists, with an average of 9.7 cuts over a career (range 1-98 cuts). Of those receiving cuts, 32.5% required stitches at an average of 1.6 times. The cuts were considered to cause permanent damage in 7.8% of the cases.

Table 5.1 Demographic information for carvers and non-carvers

| Variable | Carvers n=232 n (%) | Non-carvers n=232 n (%) | p-value+ |
|---|---|---|---|
| Age (mean SD) | 54.0 (11.8) | 50.1 (12.2) | <0.001⊥ |
| Gender: | | | |
| Male | 163 (70.3) | 102 (44.0) | <0.001 |
| Female | 69 (29.7) | 130 (56.0) | |
| Community: | | | |
| Baker Lake | 56 (24.1) | 68 (29.3) | 0.211 |
| Gjoa Haven | 33 (14.2) | 33 (14.2) | |
| Taloyoak | 28 (12.1) | 37 (15.9) | |
| Cape Dorset | 115 (49.6) | 94 (40.6) | |
| Marital status: | | | |
| Married/common law | 155 (66.8) | 160 (69.0) | 0.164 |
| Single | 29 (12.5) | 40 (17.2) | |
| Widowed | 33 (14.2) | 21 (9.1) | |
| Education*: | | | |
| No formal education | 96 (41.4) | 61 (26.3) | <0.001 |
| Grades 1-6 | 51 (22.0) | 41 (17.7) | |
| Grades 7-11 | 78 (33.6) | 117 (50.4) | |
| High school graduate | 7 (3.0) | 13 (5.6) | |
| Smoking | | | |
| Non-smoker | 10 (4.3) | 28 (12.1) | <0.001 |
| Ex-smoker | 87 (37.5) | 52 (22.4) | |
| Current smoker | 135 (58.2) | 152 (65.5) | |
| Cigarette pack-years (mean SD) | 21.4 (21.3) | 14.8 (13.9) | <0.001⊥ |

* Instruction within an institution, not including teachings by family & elders.

+ based on Pearson chi-square test, unless otherwise indicated

⊥ based on independent sample t-test

Table 5.2 Comparison of cigarette smoking characteristics of carvers and non-carvers

| Variable | Carvers (n=232) | | | Non-carvers (n=232) | | |
|---|---|---|---|---|---|---|
| | Non-smoker | Ex-smoker | Current smoker | Non-smoker | Ex-smoker | Current smoker |
| **Males** (n=265) | | | | | | |
| 35-45 years (n %) | 2 (3.3) | 15 (24.6) | 44 (72.1) | 3 (5.8) | 4 (7.7) | 45 (86.5) |
| 46-60 years (n %) | 2 (3.5) | 21 (36.8) | 34 (59.6) | 4 (12.9) | 6 (19.4) | 21 (67.7) |
| 61+ years (n %) | 1 (2.2) | 24 (53.3) | 20 (44.4) | 4 (21.1) | 10 (52.6) | 5 (26.3) |
| Pack-years (mean SD) | - | 23.7 (30.6) | 24.2 (16.3) | - | 24.1 (18.5) | 19.3 (14.8) |
| Age started (mean SD) | - | 15.8 (5.4) | 15.5 (4.6) | - | 16.9 (7.3) | 16.4 (4.9) |
| Age quit (mean SD) | - | 44.4 (14.2) | - | - | 47.6 (15.3) | - |
| Avg. # smoked/day (life) (mean SD) | - | 16.0 (12.8) | 13.4 (6.9) | - | 18.2 (14.0) | 13.5 (11.0) |
| Avg. # smoke/day (now) (mean SD) | - | - | 14.2 (7.7) | - | - | 15.6 (11.7) |
| Father smoked (n %) | 2 (40.0) | 54 (90.0) | 90 (91.8) | 11 (100.0) | 15 (75.0) | 60 (84.5) |
| Mother smoked (n %) | 3 (60.0) | 49 (81.7) | 87 (88.8) | 9 (81.8) | 16 (80.0) | 54 (76.1) |
| Spouse currently smokes (n %) | 2 (40.0) | 27 (45.0) | 53 (54.1) | 6 (54.5) | 5 (25.0) | 41 (57.7) |
| Household member smokes (n %) | 2 (40.0) | 37 (61.7) | 70 (71.4) | 5 (45.5) | 12 (60.0) | 40 (56.3) |
| **Females** (n=199) | | | | | | |
| 35-45 years (n %) | 0 (0.0) | 1 (12.5) | 7 (87.5) | 2 (3.7) | 6 (11.1) | 46 (85.2) |
| 46-60 years (n %) | 1 (3.7) | 11 (40.7) | 15 (55.6) | 9 (20.0) | 13 (28.9) | 23 (23.1) |
| 61+ years (n %) | 4 (11.8) | 15 (44.1) | 15 (44.1) | 6 (19.4) | 13 (41.9) | 12 (38.7) |
| Pack-years (mean SD) | - | 18.2 (20.7) | 18.7 (13.7) | - | 13.5 (11.8) | 14.2 (10.9) |
| Age started (mean SD) | - | 18.0 (7.5) | 19.7 (8.9) | - | 18.1 (7.5) | 17.3 (7.2) |
| Age quit (mean SD) | - | 46.9 (13.9) | - | - | 40.9 (13.2) | - |
| Avg. # smoked/day (life) (mean SD) | - | 12.3 (13.2) | 10.1 (6.1) | - | 11.9 (8.5) | 9.5 (6.9) |
| Avg. # smoke/day (now) (mean SD) | - | - | 12.4 (6.5) | - | - | 10.1 (6.4) |
| Father smoked (n %) | 4 (80.0) | 24 (88.9) | 29 (78.4) | 16 (94.1) | 31 (96.9) | 71 (87.7) |
| Mother smoked (n %) | 2 (40.0) | 26 (96.3) | 31 (83.8) | 11 (64.7) | 29 (90.6) | 66 (81.5) |
| Spouse currently smokes (n %) | 2 (40.0) | 12 (44.4) | 20 (54.1) | 4 (23.5) | 7 (21.9) | 40 (49.4) |
| Household member smokes (n %) | 1 (20.0) | 23 (85.2) | 26 (70.3) | 10 (58.8) | 22 (68.8) | 51 (63.0) |

Table 5.3 Tobacco use (other than cigarettes) for carvers and non-carvers

| Variable | Carvers (n=232 ) n (%) or mean (SD) | Non-carvers (n=232 ) n (%) or mean (SD) | p-value ⅄ |
|---|---|---|---|
| **Pipe**: | | | |
| Never smoked | 187 (81.0) | 213 (91.8) | 0.003* |
| Ex-smoker | 41 (17.7) | 17 (7.3) | |
| Current smoker | 3 (1.3) | 2 (0.9) | |
| Age started (n=63) | 20.2 (10.4) | 23.4 (20.2) | 0.405 |
| Age quit (n=58) | 36.5 (17.4) | 32.9 (21.2) | 0.508 |
| Avg. oz. smoked/week (life) (n=63) | 3.7 (14.9) | 1.4 (1.0) | 0.182 |
| Avg. oz. smoked/week (now) (n=5) | 1.5 (0.9) | 0.8 (0.4) | 0.329 |
| **Cigar**: | | | |
| Never smoked | 214 (92.6) | 228 (98.3) | 0.004* |
| Ex-smoker | 17 (7.4) | 3 (1.3) | |
| Current smoker | 0 (0.0) | 1 (0.4) | |
| Age started (n=21) | 22.3 (9.4) | 27.0 (6.5) | 0.359 |
| Age quit (n=20) | 39.9 (20.6) | 29.7 (9.2) | 0.418 |
| Avg. # smoked/week (life) (n=21) | 5.7 (6.9) | 2.3 (1.9) | 0.345 |
| Avg. # smoked/week (now) (n=1) | - | 1.00 | - |

⅄ Calculated for independent t-test statistic, unless otherwise indicated

* Calculated for Pearson chi-square test statistic

Table 5.4 Comparison of past illnesses reported by carvers and non-carvers

| Illness | Carver (n=232) n (%) | Non-carvers (n=232) n (%) | p-value* |
|---|---|---|---|
| Chest illness past 3 years | 37 (15.9) | 29 (12.5) | 0.288 |
| Lung trouble before age 16 | 60 (25.9) | 42 (18.1) | 0.083 |
| Physician confirmed bronchitis | 23 (9.9) | 17 (7.3) | 0.321 |
| Physician confirmed pneumonia | 41 (17.7) | 38 (16.4) | 0.711 |
| Physician confirmed current asthma | 19 (8.2) | 17 (7.3) | 0.729 |
| Physician confirmed tuberculosis | 92 (39.7) | 68 (29.3) | 0.019 |
| Chest injury | 24 (10.3) | 11 (4.7) | 0.022 |
| Hay fever | 34 (14.7) | 28 (12.1) | 0.440 |
| Eczema | 44 (19.0) | 17 (7.3) | 0.001 |
| Hives | 38 (16.4) | 31 (13.4) | 0.406 |
| Physician confirmed heart troubles | 31 (13.4) | 30 (12.9) | 0.602 |

* calculated using Pearson chi-square test statistic

Table 5.5 Comparison of allergic symptoms reported by carvers and non-carvers

| Symptom | Carvers (n=232) n (%) | Non-carvers (n=232) n (%) | p-value* |
|---|---|---|---|
| **Animals, dusts & feathers** | | | |
| Cough | 21 (9.1) | 18 (7.8) | 0.530 |
| Wheeze | 13 (5.6) | 10 (4.3) | 0.490 |
| Chest tightness | 7 (3.0) | 8 (3.4) | 0.587 |
| Shortness of breath | 8 (3.5) | 11 (4.7) | 0.476 |
| Runny/stuffy nose | 16 (6.9) | 24 (10.3) | 0.257 |
| Itchy/watery eyes | 16 (6.9) | 16 (6.9) | 0.606 |
| **Grass, plants, flowers & pollen** | | | |
| Cough | 4 (1.7) | 2 (0.9) | 0.430 |
| Wheeze | 1 (0.4) | 3 (1.3) | 0.367 |
| Chest tightness | 2 (0.9) | 3 (1.3) | 0.549 |
| Shortness of breath | 2 (0.9) | 4 (1.7) | 0.434 |
| Runny/stuffy nose | 3 (1.3) | 5 (2.2) | 0.472 |
| Itchy/watery eyes | 3 (1.3) | 4 (1.7) | 0.565 |

*Calculated using Pearson chi-square test statistic

Table 5.6 Comparison of home environment between carvers and non-carvers

| Variable* | Carvers (n=232) n (%) or mean (SD) | Non-carvers (n=232) n (%) or mean (SD) | p-value+ |
|---|---|---|---|
| Years living in current home | 9.9 (11.1) | 7.5 (7.3) | 0.007⊥ |
| Years living in community | 39.8 (15.3) | 38.5 (14.6) | 0.319⊥ |
| **Home Built** | | | |
| Before 1960 | 3 (1.4) | 3 (1.5) | 0.075 |
| 1961-1970 | 31 (14.2) | 21 (10.2) | |
| 1971-1980 | 61 (28.0) | 46 (22.3) | |
| 1981+ | 123 (56.4) | 136 (66.0) | |
| **Type of Building** | | | |
| Mobile/trailer | 0 (0) | 2 (0.9) | 0.144 |
| One single family | 181 (78.0) | 159 (68.5) | |
| Attached single family | 16 (6.9) | 20 (8.6) | |
| Building 2 families | 12 (5.2) | 18 (7.8) | |
| Building 5+ families | 23 (9.9) | 33 (14.2) | |
| **Heating & Hot Water** | | | |
| Electric heater | 11 (4.8) | 7 (3.0) | 0.213 |
| Paraffin heater | 1 (0.4) | 0 (0.0) | |
| Gas-fired boiler | 6 (2.6) | 14 (6.1) | |
| Oil-fired boiler | 213 (92.2) | 210 (90.9) | |
| **Stove** | | | |
| Gas | 1 (0.4) | 1 (0.4) | 0.606 |
| Electric | 230 (99.2) | 231 (99.6) | |
| Coleman | 1 (0.4) | 0 (0.0) | |
| **Fan above Stove** | | | |
| Present over cooker | 216 (93.1) | 224 (96.6) | 0.094 |
| Use of fan (n=439): | | | |
| Always | 52 (24.2) | 52 (23.2) | 0.360 |
| Sometimes | 149 (69.3) | 164 (73.2) | |
| Never | 14 (6.5) | 8 (3.6) | |
| Takes fumes outside | 184 (85.6) | 195 (87.1) | 0.538 |
| **Mould/Water Damage** | | | |
| Mould ever present | 36 (15.6) | 26 (11.2) | 0.233 |
| Last 12 mos. (n=62) | 19 (52.8) | 19 (76.0) | 0.092 |
| Water damage ever | 53 (22.9) | 39 (16.8) | 0.154 |
| Last 12 mo. (n=92) | 25 (47.2) | 17 (43.6) | 0.733 |
| **Humidifier** | | | |
| Use | 73 (31.6) | 76 (32.8) | 0.585 |
| Type (n=149): | | | |
| Built in heating system | 6 (8.2) | 8 (10.5) | 0.269 |
| Portable cold mist | 23 (31.5) | 30 (39.5) | |
| Portable hot mist | 26 (35.6) | 16 (21.1) | |
| Boiling water | 18 (24.7) | 22 (28.9) | |

* N=464 unless otherwise stated

+ Calculated from Pearson chi-square test statistic, unless otherwise indicated

⊥ Calculated from independent t-test statistic

Table 5.7 Industries where exposures to vapours, gas, dust or fumes occurred for carvers and non-carvers*

| Industry | Carvers (n=89 jobs) Age/Gender (n) | | | | | | Non-carvers (n=65 jobs) Age/Gender (n) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35-45 | | 46-60 | | 61-88 | | 35-45 | | 46-60 | | 61-88 | |
| | M | F | M | F | M | F | M | F | M | F | M | F |
| Mining | 5 | 0 | 2 | 0 | 3 | 0 | 5 | 0 | 3 | 0 | 0 | 0 |
| Housing | 8 | 0 | 5 | 1 | 6 | 1 | 9 | 0 | 0 | 0 | 0 | 0 |
| Airline | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 1 |
| Road maintenance | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Fuel delivery | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Water delivery | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Truck contracting | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Sewage | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Garbage | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 4 | 0 | 0 | 0 |
| Hazardous waste | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Administration/office | 4 | 0 | 6 | 0 | 1 | 1 | 2 | 2 | 1 | 0 | 0 | 1 |
| Enforcement | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crafts and printing | 2 | 0 | 4 | 1 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 1 |
| Arena/sports | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Professional | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 0 | 1 |
| Carpentry | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power corp. | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| Manufacturing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| Maintenance | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| Mechanic/garage | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Hospitality services | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Painting | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| Oil & gas industry | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Retail | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Fire fighting | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fishing | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Housework | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 33 | 0 | 31 | 6 | 15 | 4 | 31 | 8 | 13 | 4 | 4 | 5 |

*134 individuals reported 154 jobs, does not include stone carving

M = males, F = females

Table 5.8 Types of occupational exposures reported by carvers and non-carvers*

| Exposure | Carvers (n=109 exposure types) Age/Gender (n) | | | | | | Non-carvers (n=90 exposure types) Age/Gender (n) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35-45 | | 46-60 | | 61-88 | | 35-45 | | 46-60 | | 61-88 | |
| | M | F | M | F | M | F | M | F | M | F | M | F |
| **Dusts:** | | | | | | | | | | | | |
| Dust-general | 3 | 0 | 5 | 1 | 3 | 1 | 8 | 3 | 4 | 1 | 0 | 2 |
| Drywall | 3 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Wood | 3 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 0 |
| Antler | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Metal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Lead | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zinc | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Duffle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Furnace | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Stone/rock/gravel | 2 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 0 |
| Chalk | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Insulation fibres | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **Fumes:** | | | | | | | | | | | | |
| Fumes – general | 3 | 0 | 2 | 0 | 1 | 1 | 2 | 0 | 4 | 2 | 0 | 0 |
| Smoke | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Diesel | 5 | 0 | 5 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 1 | 0 |
| Fuel | 6 | 0 | 1 | 0 | 2 | 0 | 7 | 0 | 1 | 0 | 1 | 1 |
| Furnace | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 |
| Oil | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Glue | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sewage | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Paint | 9 | 0 | 6 | 1 | 3 | 1 | 6 | 1 | 2 | 1 | 2 | 0 |
| Welding | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Propane | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Jet exhaust | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Gas exhaust | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |

Table 5.8 continued

| Exposures | Carvers | | | | | | Non-carvers | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35-45 | | 46-60 | | 61-88 | | 35-45 | | 46-60 | | 61-88 | |
| | M | F | M | F | M | F | M | F | M | F | M | F |
| **Chemicals:** | | | | | | | | | | | | |
| Cleaning products | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 1 |
| Printing | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Acids | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| PCB's | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Anti-freeze | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Antiseptics | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Plastics | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Total | 47 | 0 | 36 | 6 | 16 | 4 | 43 | 10 | 20 | 5 | 6 | 6 |

* 134 individuals reported 199 exposure types
M = males, F= females

Table 5.9 Individual jobs left or changed due to breathing difficulties in various occupations

| ID | Industry | Exposure | Time exposed | Community | Gender | Current Age | Carver Status |
|---|---|---|---|---|---|---|---|
| 1 | Mining | Nickel dust | 1 year | Baker Lake | Male | 66 | Yes |
| 2 | House keeping | House dust | 13 years | Baker Lake | Female | 47 | Yes |
| 3 | Janitorial | Cleaning products | 7 years | Baker Lake | Female | 62 | Yes |
| 4 | Manufacturing | Aluminium | 25 years | Baker Lake | Male | 77 | No |
| 5 | Mining | Lead & zinc dust | 7 years | Gjoa Haven | Male | 66 | Yes |
| 6 | Power Corp. | Chemical fumes | 29 years | Gjoa Haven | Male | 53 | Yes |
| 7 | Manufacturing | Duffle dust | 4 years | Taloyoak | Female | 66 | Yes |
| 8 | Manufacturing | Duffle dust | 5 years | Taloyoak | Female | 54 | No |
| 9 | Mining | Lead & zinc dust | 2.5 years | Cape Dorset | Male | 39 | Yes |
| 10 | Housing | Insulating, dusts | 20 years | Cape Dorset | Male | 57 | Yes |

Table 5.10 Carving production by community of residence

| Variable | Baker Lake n (%) or mean (SD) | Gjoa Haven n (%) or mean (SD) | Taloyoak n (%) or mean (SD) | Cape Dorset n (%) or mean (SD) | Total n (%) or mean (SD) |
|---|---|---|---|---|---|
| **Carvers** | 56 | 33 | 28 | 115 | 232 |
| Avg. years carving | 16.4 13.1 | 10.8 11.5 | 15.5 12.9 | 21.0 15.7 | 17.8 14.63 |
| Avg. number of carvings (lifetime) | 1057.6 2456.5 | 1449.7 4272.8 | 1482.7 3301.6 | 1574.9 2508.6 | 1421.1 2896.6 |
| **Additional Carving Materials:** | | | | | |
| Ivory | 13 (23.2) | 12 (36.4) | 14 (50.0) | 42 (36.5) | 81 (34.9) |
| Antler | 43 (76.8) | 22 (66.7) | 24 (85.7) | 52 (45.2) | 141 (60.8) |
| Bone | 23 (41.1) | 20 (60.6) | 21 (75.0) | 23 (20.0) | 87 (37.5) |
| **Carving Production:** | | | | | |
| Size of carvings: | | | | | |
| Large | 0 (0.0) | 0 (0.0) | 1 (3.6) | 9 (7.8) | 10 (4.3) |
| Medium | 11 (19.6) | 3 (9.1) | 8 (28.6) | 27 (23.5) | 49 (21.1) |
| Small | 16 (28.6) | 9 (27.3) | 5 (17.9) | 34 (29.6) | 64 (27.6) |
| Variable | 29 (51.8) | 21 (63.6) | 14 (50.0) | 45 (39.1) | 109 (50.0) |
| Local stone used | 53 (94.6) | 22 (66.7) | 22 (78.6) | 24 (20.9) | 121 (52.2) |
| Stone from other areas (n=230) | 16 (28.6) | 22 (71.0) | 13 (46.4) | 101 (87.8) | 152 (66.1) |
| Power tools used for carving | 32 (57.1) | 24 (72.7) | 13 (46.4) | 81 (70.4) | 150 (64.7) |
| Avg. years used tools (n=150) | 11.5 9.6 | 10.1 9.7 | 16.2 10.5 | 7.0 5.6 | 9.2 8.2 |
| Power tools used for sanding | 12 (21.4) | 7 (21.2) | 6 (21.4) | 9 (7.8) | 34 (14.7) |

Table 5.11 Seasonal carving venue by community of residence

| Variable | Baker Lake n (%) or mean (SD) | Gjoa Haven n (%) or mean (SD) | Taloyoak n (%) or mean (SD) | Cape Dorset n (%) or mean (SD) | Total n (%) or mean (SD) |
|---|---|---|---|---|---|
| **Summer carving** | 56 (100.0) | 28 (84.8) | 27 (96.4) | 114 (99.1) | 225 (97.0) |
| Where carve in summer (n=225): | | | | | |
| Outdoors | 54 (96.4) | 22 (78.6) | 24 (88.9) | 114 (100.0) | 214 (95.1) |
| Indoors (home), separate rm. | 0 (0.0) | 1 (3.6) | 1 (3.7) | 0 (0.0) | 2 (0.9) |
| Indoors (home), not separate | 0 (0.0) | 1 (3.6) | 1 (3.7) | 0 (0.0) | 2 (0.9) |
| Indoors, separate building | 1 (1.8) | 2 (7.1) | 1 (3.7) | 0 (0.0) | 4 (1.8) |
| Group studio | 1 (1.8) | 1 (3.6) | 0 (0.0) | 0 (0.0) | 2 (0.9) |
| Carve outdoors, sand indoors | 0 (0.0) | 1 (3.6) | 0 (0.0) | 0 (0.0) | 1 (0.4) |
| **Winter carving:** | 40 (71.4) | 25 (75.8) | 26 (92.9) | 108 (93.9) | 199 (85.8) |
| Where carve in winter (n=199): | | | | | |
| Outdoors | 30 (75.0) | 16 (64.0) | 19 (73.1) | 107 (99.1) | 172 (86.5) |
| Indoors (home), separate rm. | 2 (5.0) | 2 (8.0) | 5 (19.20 | 1 (0.9) | 10 (5.0) |
| Indoors (home), not separate | 3 (7.5) | 1 (4.0) | 1 (3.8) | 0 (0.0) | 5 (2.5) |
| Indoors, separate building | 1 (2.5) | 2 (8.0) | 0 (0.0) | 0 (0.0) | 3 (1.5) |
| Group studio | 1 (2.5) | 2 (8.0) | 0 (0.0) | 0 (0.0) | 3 (1.5) |
| Porch | 1 (2.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.5) |
| Shop | 1 (2.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.5) |
| Outdoors & indoors | 1 (2.5) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (0.5) |
| Carve outdoors, sand indoors, separate rm. | 0 (0.0) | 1 (4.0) | 1 (3.8) | 0 (0.0) | 2 (1.0) |

Table 5.12 Dust mask usage by community of residence

| Variable | Baker Lake n (%) or mean (SD) | Gjoa Haven n (%) or mean (SD) | Taloyoak n (%) or mean (SD) | Cape Dorset n (%) or mean (SD) | Total n (%) or mean (SD) |
|---|---|---|---|---|---|
| Wear dust mask | 25 (44.6) | 26 (78.8) | 16 (57.1) | 67 (58.3) | 134 (57.8) |
| When wear mask (n=134): | | | | | |
| Always | 4 (16.0) | 9 (34.6) | 7 (43.7) | 18 (26.9) | 38 (28.4) |
| Most of the time | 3 (12.0) | 7 (26.9) | 3 (18.8) | 15 (22.4) | 28 (20.9) |
| Sometimes | 7 (28.0) | 9 (34.6) | 6 (37.5) | 24 (35.8) | 46 (34.3) |
| Not often | 11 (44.0) | 1 (3.9) | 0 (0.0) | 10 (14.9) | 22 (16.4) |
| Problems with mask freezing (n=134) | 11 (44.0) | 12 (46.2) | 10 (62.5) | 29 (43.3) | 62 (46.3) |

Table 5.13 Injuries incurred during carving by community of residence

| Variable | Baker Lake n (%) or mean (SD) | Gjoa Haven n (%) or mean (SD) | Taloyoak n (%) or mean (SD) | Cape Dorset n (%) or mean (SD) | Total n (%) or mean (SD) |
|---|---|---|---|---|---|
| Injured eye (n=232) | 10 (17.9) | 3 (9.4) | 4 (14.3) | 27 (23.5) | 44 (19.0) |
| Permanent damage to eye (n=44) | 2 (20.0) | 0 (0.0) | 0 (0.0) | 4 (14.8) | 6 (13.6) |
| Hand/arm infection (n=231) | 6 (10.7) | 2 (6.3) | 5 (17.9) | 11 (9.6) | 24 (10.4) |
| Cut (n=231) | 14 (25.0) | 7 (21.9) | 12 (42.9) | 44 (38.3) | 77 (33.3) |
| Avg. number of cuts (n=77) | 9.4 10.7 | 5.3 4.0 | 3.7 2.7 | 12.2 22.0 | 9.7 17.5 |
| Stitches required (n=77) | 2 (14.3) | 1 (14.3) | 4 (33.3) | 18 (40.9) | 25 (32.5) |
| Avg. times stitches required (n=77) | 1.5 0.7 | 1.0 | 1.0 | 1.8 1.4 | 1.6 1.2 |
| Permanent damage (n=77) | 1 (7.1) | 1 (14.3) | 1 (8.3) | 3 (6.8) | 6 (7.8) |

# CHAPTER 6: RESULTS - SYMPTOMS

The purpose of this chapter is to report the prevalence of selected respiratory symptoms in the study population. This chapter examines the bivariate relationship between potential predictor variables and the outcome of interest, symptoms, which were described in chapter 4. Multivariate analyses are then presented, to identify the most significant predictors of reported symptoms, when the effects of other predictor variables were controlled.

Variables analysed in this chapter were those selected for statistical or practical association with the outcomes of interest, and/or those that have been reported in the literature. As this study is of cross-sectional design, any variables found to be significant should be considered associative, and not causal.

## 6.1 Prevalence of Respiratory Symptoms and Bivariate Associations

Participants were asked a series of questions concerning respiratory symptoms. Figure 6.1 illustrates the prevalence of these symptoms reported by carvers and non-carvers.

When asked if participants usually had a cough, 29.3% of carvers and 27.6% of non-carvers indicated this was the case (p=0.681) (table 6.1). Current smokers had increased odds of reporting coughing compared to non-smokers [OR=2.33; 95% CI: 0.99-5.49]. Cigarette pack-years also showed an association for reporting cough (p<0.001), as did community of residence (p<0.001). Residents of Gjoa Haven had significantly decreased odds of reporting cough [OR=0.16; 95% CI: 0.07-0.41].

Chronic cough, defined as coughing most days for ≥ 3 consecutive months, for ≥ 2 years, was reported by 17.7% of carvers and 15.1% of non-carvers (p=0.452) (table 6.2). The mean age of those reporting chronic cough was 55.0 years (SD=14.0), significantly older than those not reporting chronic cough (51.5 years, SD=11.7, p=0.041). The mean cigarette pack-years of those reporting chronic cough was 28.5 (SD=28.2), significantly higher than those not reporting this symptom (16.1 pack-years, SD=14.9, p<0.001). As with usual cough, residents

of Gjoa Haven had significantly decreased odds of reporting chronic cough [OR=0.19; 95% CI:0.06-0.65].

Usually bringing up phlegm from the chest was reported by 34.1% of carvers and 26.7% of non-carvers (p=0.086) (table 6.3). Participants who worked with both stone and organic materials for their art had increased odds of reporting usual phlegm compared to non-carvers [OR=1.91; 95% CI: 1.22-2.98]. The mean age of those reporting usual phlegm was 56.2 years (SD=12.6), significantly older than those not reporting phlegm (50.2 years, SD=11.5, p<0.001). The mean cigarette pack-years of those reporting phlegm was 23.0 (SD=24.3), significantly higher than those not reporting this symptom (16.0, SD=14.5, p<0.001). Residents of Gjoa Haven had significantly decreased odds of reporting phlegm [OR=0.18; 95% CI:0.08-0.40], as did residents of Cape Dorset [OR=0.30; 95% CI: 0.19-0.49].

Chronic phlegm, defined as producing phlegm most days for ≥ 3 consecutive months, for ≥ 2 years, was reported by 24.1% of carvers and 17.7% of non-carvers (p=0.087) (table 6.4). The mean age of those reporting chronic phlegm was 56.3 years (SD=12.5), significantly older than those not reporting chronic phlegm (50.9 years, SD=11.8, p<0.001). The mean cigarette pack-years of those reporting chronic phlegm was 26.2 (SD=26.4), significantly higher than those not reporting this symptom (16.0, SD=14.8, p<0.001). Residents of Gjoa Haven had significantly decreased odds of reporting chronic phlegm [OR=0.19; 95% CI:0.07-0.52], as did residents of Cape Dorset [OR=0.43; 95% CI: 0.25-0.73].

Shortness of breath was determined by questioning whether troubles with shortness of breath were present when hurrying on a level or walking up a slight hill. 45.3% of carvers and 37.9% of non-carvers reported shortness of breath (p=0.109) (table 6.5). The mean age of those reporting shortness of breath was 55.2 years (SD=12.3), significantly older than those not reporting shortness of breath (49.8 years, SD=11.6, p<0.001). The mean cigarette pack-years of those reporting shortness of breath was 22.0 (SD=22.2), significantly higher than those not reporting this symptom (15.4, SD=14.4, p<0.001).

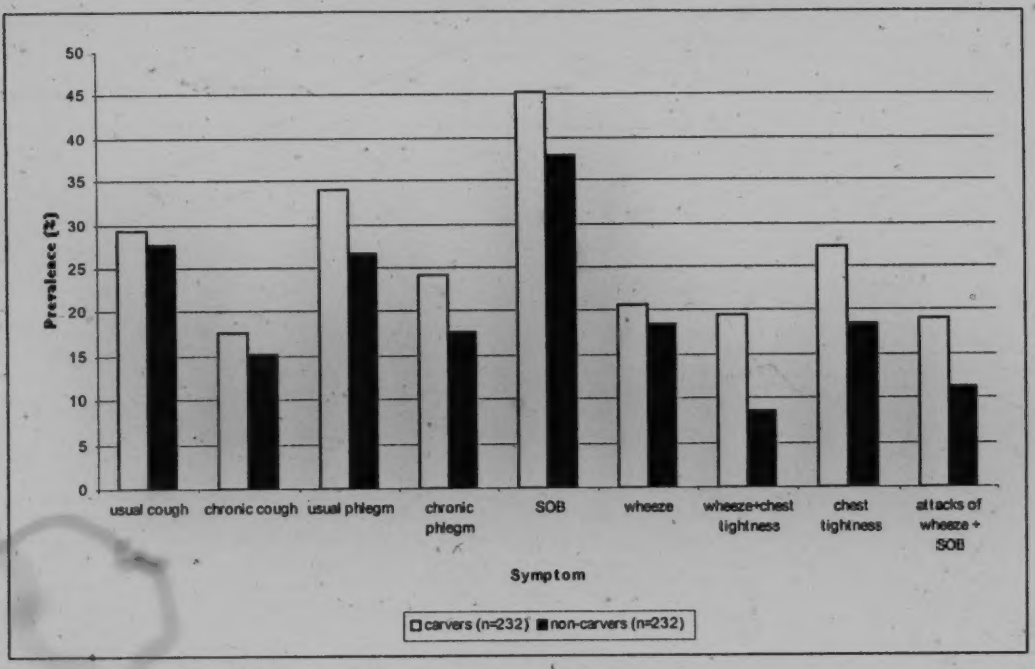
Wheeze in the absence of a cold was reported by 20.7% of carvers and 18.5% of non-carvers (p=0.559) (table 6.6). The mean cigarette pack-years of those reporting shortness of breath was 24.7 (SD=26.7), significantly higher than those not reporting this symptom (16.5, SD=15.2, p=0.006).

Almost 20% of carvers and 8.6% of non-carvers reported wheezing associated with chest tightness [OR=2.55; 95% CI: 1.45-4.48] (table 6.7). When examining types of media used in artworks, the odds of reporting wheeze associated with chest tightness for those carving with only stone were significantly higher than non-carvers [OR=3.00; 95% CI: 1.40-6.43]. Additionally, the odds of reporting this symptom for those carving with both stone and organic media were significantly higher than non-carvers [OR=2.83; 95% CI: 1.48-5.41]

The odds of carvers having reported chest tightness were significantly higher than non-carvers [OR=1.64; 95% CI: 1.06-2.54] (table 6.8). 27.2% of carvers and 18.5% of non-carvers reported chest tightness. When examining types of media used in artworks, the odds of reporting chest tightness for those carving with only stone did not differ from non-carvers [OR=1.06; 95% CI: 0.54-2.10]. The odds of reporting this symptom for those carving with both stone and organic media were significantly higher than non-carvers [OR=2.10; 95% CI: 1.28-3.42].

The odds of carvers having reported attacks of wheeze with shortness of breath were significantly higher than non-carvers [OR=1.85; 95% CI: 1.10-3.13] (table 6.9). 19.0% of carvers and 11.2% of non-carvers reported wheeze attacks accompanied by shortness of breath. When examining types of media used in artworks, the odds of reporting chest tightness for those carving with just stone were non-significantly higher than non-carvers [OR=1.10; 95% CI: 0.48-2.49]. The odds of reporting this symptom for those carving with both stone and organic media were significantly higher than non-carvers [OR=2.31; 95% CI: 1.30-4.10]. The mean age of those reporting wheeze attacks with shortness of breath was 56.8 years (SD=12.3), significantly older than those not reporting this symptom (51.3 years, SD=11.9, p=0.001). Residents of Gjoa Haven had significantly decreased odds of reporting wheeze attacks with shortness of breath [OR=0.18; 95% CI: 0.05-0.62].

Figure 6.1 Prevalence of symptoms reported by carvers and non-carvers




SOB=shortness of breath

## 6.2 Multivariate Analyses

Logistic regression was performed for each symptom of interest. For discrete variables being entered as independent variables, the resulting odds ratio is a ratio of the odds of experiencing the outcome (symptom) for those in one category vs. the odds of experiencing the outcome in the other (reference) category. For continuous variables, the odds ratio is an estimate of the odds of experiencing the outcome associated with one unit increase in the independent variable (Kleinbaum et al 1998).

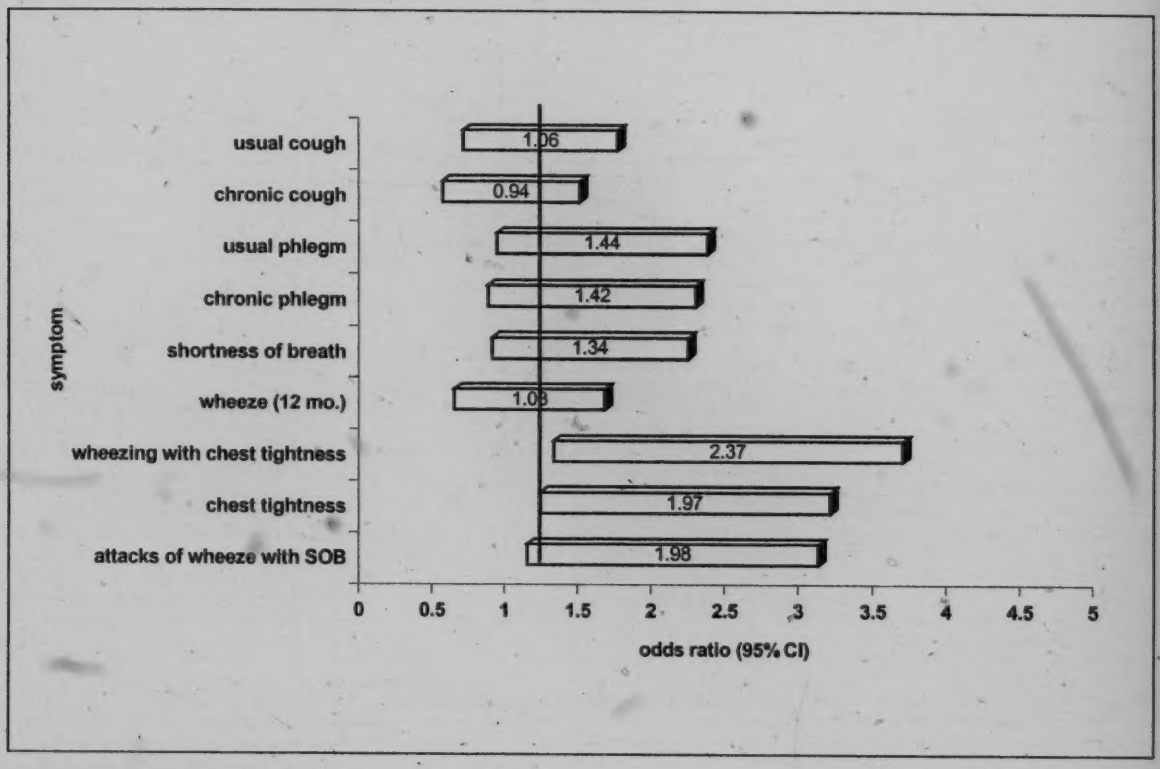
Prior to conducting the analyses, independent variables were tested to determine whether they satisfied the assumptions of logistic regression (outlined in chapter 4):

1. The cases were independent since each participant had only one opportunity to participate in the study.
2. Linearity of continuous variables was tested using logit plots. Logit plots were examined for all continuous variables including: age, and cigarette pack-years. Only age satisfied the linear assumption and was entered into the models in its continuous form. Cigarette pack-years was categorized based on natural breaks observed in the data.
3. Multicollinearity was checked for variables being entered into the model. No variables showed strong associations.
4. No missing cases were noted for variables of interest.
5. When examining the bivariate analysis, upon cross-tabulation with the symptoms of interest, the variable "smoking status", displayed small cell counts, demonstrating near-complete separation. This variable was excluded from the analysis on the basis of a lack of discriminatory power across categories. Additionally, smoking status did not show strong associations in the bivariate analysis. The variable cigarette pack-years was the only smoking variable entered into the models.

For each of the symptoms of interest, logistic regression was carried out as described in chapter 4. Figure 6.2 provides adjusted odds ratios for reporting of the selected symptoms for carvers compared to non-carvers.

Tables 6.10-6.18 provide the final models obtained for each symptom using logistic regression. For all symptoms, the final model contained variables entered into the model that were of biological or statistical significance. Interaction, or effect modification, refers to variation in the magnitude of one variable across the level of another variable (Rothman & Greenland 1998). Interaction between variables in all models was tested by entering each interaction term into the model, one at a time. None of the interaction terms demonstrated statistical significance at the 5% level. Therefore, no interactions were included in the final models.

Figure 6.2 Adjusted* odds ratios and 95% confidence intervals for selected respiratory symptoms, comparing carvers to non-carvers




SOB=shortness of breath
*variables included in model: age, gender, community of residence, cigarette pack-years

As in the bivariate analysis (section 6.1), symptoms suggestive of bronchial responsiveness were reported significantly more often by carvers than non-carvers in the multivariate analysis. The odds of carvers having reported wheezing associated with chest tightness were significantly higher than non-carvers [OR=2.37; 95% CI: 1.30-4.34]. The odds of carvers having reported chest tightness were significantly higher than non-carvers [OR=1.97; 95% CI: 1.21-3.21]. Finally, the odds of carvers having reported attacks of wheezing with shortness of breath were significantly higher than non-carvers [OR=1.98; 95% CI: 1.12-3.50].

## 6.3 Carving Media and Respiratory Symptoms

Of the 232 carvers participating in this study, 75 had only used stone as their medium, whereas 159 carvers used both stone and organic media (ivory, antler, and bone) (table 5.10). Logistic regression was repeated for all symptoms of interest, examining the contribution of media type used in the outcomes of interest. The odds ratios and 95% confidence intervals are presented for each symptom of interest for these two carving groups, in comparison to non-carvers, in table 6.19.

The odds of either of the carving groups having reported usual or chronic cough were not significantly higher than non-carvers. The odds of stone + organic carvers having reported usual phlegm were significantly higher than non-carvers [OR=1.66; 95% CI: 1.02-2.70]. This was not the case for carvers using stone only [OR=0.94; 95% CI: 0.48-1.87]. Chronic phlegm was not found to be significant in either group, neither was shortness of breath and wheezing in the last twelve months.

For those carving with stone and organic media, the odds of having reported wheeze with chest tightness was significantly higher than non-carvers [OR=2.54; 95% CI: 1.32-4.91]. The odds of this group reporting chest tightness were significantly higher than non-carvers [OR=2.44; 95% CI: 1.43-4.16]. Additionally, the odds of this group reporting attacks of wheeze with shortness of breath were significantly higher than non-carvers [OR=2.66; 95% CI: 1.41-5.02].

For those carving with only stone, the odds of this group having reported wheeze with chest tightness was significantly higher than non-carvers [OR=2.79; 95% CI: 1.29-6.00]. The odds of reporting chest tightness and attacks of wheeze with shortness of breath were not found to be significantly higher than non-carvers.

## 6.4 Exposure-response

Carvers in the study were categorised into groups based exposure to carving dust. Two separate variables were created to assess this relationship. Firstly, the number of years

carving was investigated in logistic regression analysis using a categorical variable with the following three levels:

1) Less than 10 years carving (n=105);
2) Between 11 and 25 years (n=61),
3) More than 25 years of carving (n=66).

Secondly, the number of pieces carved during a carver's career was examined using logistic regression. The number of pieces carved was estimated for each carver using the following equation:

(average carvings made per week) * (4 weeks) * (average months spent carving in a year) * (number of years carving)

The number of pieces carved was assessed as a categorical variable using the following three levels:

1) Less than 100 pieces carved during career (n=102);
2) Between 101 and 1000 pieces carved (n=70);
3) More than 1000 pieces carved (n=60).

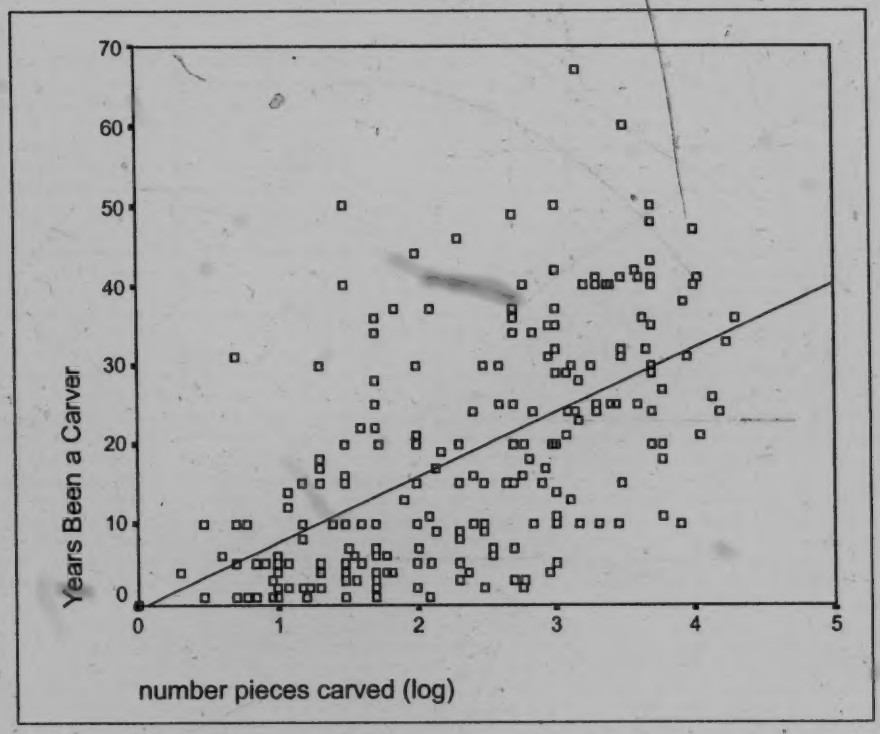
The two variables were assessed separately due to their association, in an attempt to avoid multicollinearity in the regression analysis. Figure 6.3 shows the linear association between carving years and pieces carved. Number of pieces carved is shown as a log transformed variable due to the marked skewness this variable.

There was little evidence of exposure-response patterns in the odds ratios when examined by years of carving (table 6.20) or the number of pieces of art produced (table 6.21). The exception was wheeze with chest tightness in relation to the number of pieces carved.

Notably, neither cough nor phlegm was significantly related to a history of carving (table 6.20), although odds ratios were generally greatest in the highest categories of years of carving and number of pieces carved. The odds ratios for chronic phlegm showed some

evidence of an exposure-response relationship with the number of years carved (table 6.21). No strongly suggestive patterns were found for cough.

Figure 6.3 Exposure to stone dust assessing years of carving and amount of pieces carved




Pearson correlation coefficient=0.80, $p<0.01$

Table 6.1 Bivariate association of selected variables with usual cough

| Variable+ | Usual Cough Yes n (%) | Usual Cough No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 64 (27.6) | 168 (72.4) | 1.09 | 0.73-1.63 | 0.681 |
| Carver | 68 (29.3) | 164 (70.7) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 59 (28.4) | 149 (71.6) | | | |
| Stone only | 20 (26.7) | 55 (73.3) | 0.918 | 0.51-1.66 | 0.809 |
| Stone & organic | 48 (30.6) | 109 (69.4) | 1.112 | 0.71-1.75 | |
| GENDER | | | | | |
| Female | 57 (28.6) | 142 (71.4) | 0.98 | 0.65-1.48 | 0.936 |
| Male | 75 (28.3) | 190 (71.7) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 52.9 (12.8) | 51.7 (11.9) | 1.01 | 0.99-1.03 | 0.332 |
| SMOKING STATUS | | | | | |
| Non-smoker | 7 (18.4) | 31 (81.6) | | | |
| Ex-smoker | 26 (18.7) | 113 (81.3) | 1.02 | 0.40-2.57 | 0.001 |
| Current smoker | 99 (34.5) | 188 (65.5) | 2.33 | 0.99-5.49 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 24.7 (25.1) | 15.5 (14.0) | 1.03 | 1.02-1.04 | <0.001 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 83 (27.3) | 221 (72.7) | 1.18 | 0.77-1.79 | 0.451 |
| Yes | 49 (30.6) | 111 (69.4) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 47 (37.9) | 77 (62.1) | | | |
| Gjoa Haven | 6 (9.1) | 60 (90.9) | 0.16 | 0.07-0.41 | <0.001 |
| Taloyoak | 21 (32.3) | 44 (67.7) | 0.78 | 0.42-1.47 | |
| Cape Dorset | 58 (27.8) | 151 (72.2) | 0.63 | 0.39-1.01 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.2 Bivariate association of selected variables with chronic cough

| Variable+ | Chronic Cough Yes n (%) | Chronic Cough No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 35 (15.1) | 197 (84.9) | 1.21 | 0.74-1.98 | 0.452 |
| Carver | 41 (17.7) | 191 (82.3) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 33 (15.9) | 175 (84.1) | | | |
| Stone only | 10 (13.3) | 65 (86.7) | 0.82 | 0.38-1.75 | 0.417 |
| Stone & organic | 31 (19.7) | 126 (80.3) | 1.31 | 0.76-2.24 | |
| GENDER | | | | | |
| Female | 27 (13.6) | 172 (86.4) | 1.45 | 0.87-2.41 | 0.606 |
| Male | 49 (18.5) | 216 (81.5) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 55.0 (14.0) | 51.5 (11.7) | 1.02 | 1.00-1.04 | 0.041 |
| SMOKING STATUS | | | | | |
| Non-smoker | 4 (10.5) | 34 (89.5) | | | |
| Ex-smoker | 17 (12.2) | 122 (87.8) | 1.18 | 0.37-3.75 | 0.115 |
| Current smoker | 55 (19.2) | 232 (80.8) | 2.02 | 0.69-5.92 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 28.5 (28.2) | 16.1 (14.9) | 1.03 | 1.02-1.05 | <0.001 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 48 (15.8) | 256 (84.2) | 1.13 | 0.68-1.89 | 0.636 |
| Yes | 28 (17.5) | 132 (82.5) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 25 (20.2) | 99 (79.8) | | | |
| Gjoa Haven | 3 (4.5) | 63 (95.5) | 0.19 | 0.06-0.65 | 0.017 |
| Taloyoak | 15 (23.1) | 50 (76.9) | 1.19 | 0.58-2.45 | |
| Cape Dorset | 33 (15.8) | 176 (84.2) | 0.74 | 0.42-1.32 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.3 Bivariate association of selected variables with usual phlegm.

| Variable+ | Usual Phlegm Yes n (%) | Usual Phlegm No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 62 (26.7) | 170 (73.3) | 1.42 | 0.95-2.11 | 0.086 |
| Carver | 79 (34.1) | 153 (65.9) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 53 (25.5) | 155 (74.5) | | | |
| Stone only | 17 (22.7) | 58 (77.3) | 0.86 | 0.46-1.60 | 0.005 |
| Stone & organic | 62 (39.5) | 95 (60.5) | 1.91 | 1.22-2.98 | |
| GENDER | | | | | |
| Female | 63 (31.7) | 136 (68.3) | 0.90 | 0.60-1.34 | 0.606 |
| Male | 78 (29.4) | 187 (70.6) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 56.2 (12.6) | 50.2 (11.5) | 1.04 | 1.02-1.06 | <0.001 |
| SMOKING STATUS | | | | | |
| Non-smoker | 12 (31.6) | 26 (68.4) | | | |
| Ex-smoker | 40 (28.8) | 99 (71.2) | 0.88 | 0.40-1.90 | 0.883 |
| Current smoker | 89 (31.0) | 198 (69.0) | 0.97 | 0.47-2.02 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 23.0 (24.3) | 16.0 (14.5) | 1.02 | 1.01-1.03 | <0.001 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 88 (28.9) | 216 (71.1) | 1.216 | 0.81-1.84 | 0.352 |
| Yes | 53 (33.1) | 107 (66.9) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 58 (46.8) | 66 (53.2) | | | |
| Gjoa Haven | 9 (13.6) | 57 (86.4) | 0.18 | 0.08-0.40 | <0.001 |
| Taloyoak | 30 (46.2) | 35 (53.8) | 0.98 | 0.53-1.78 | |
| Cape Dorset | 44 (21.1) | 165 (78.9) | 0.30 | 0.19-0.49 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.4 Bivariate association of selected variables with chronic phlegm

| Variable+ | Chronic Phlegm Yes n (%) | Chronic Phlegm No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 41 (17.7) | 191 (82.3) | 1.48 | 0.94-2.33 | 0.087 |
| Carver | 56 (24.1) | 176 (75.9) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 35 (16.8) | 173 (83.2) | | | |
| Stone only | 14 (18.7) | 61 (81.3) | 1.13 | 0.57-2.25 | 0.061 |
| Stone & organic | 42 (26.8) | 115 (73.2) | 1.81 | 1.09-2.30 | |
| GENDER | | | | | |
| Female | 41 (20.6%) | 158 (79.4) | 1.03 | 0.66-1.62 | 0.890 |
| Male | 56 (21.1%) | 209 (78.9) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 56.3 (12.5) | 50.9 (11.8) | 1.04 | 1.02-1.06 | <0.001 |
| SMOKING STATUS | | | | | |
| Non-smoker | 3 (7.9) | 35 (92.1) | | | |
| Ex-smoker | 28 (20.1) | 111 (79.9) | 2.94 | 0.84-10.27 | 0.095 |
| Current smoker | 66 (23.0) | 221 (77.0) | 3.48 | 1.04-11.69 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 26.2 (26.4) | 16.0 (14.8) | 1.03 | 1.02-1.04 | <0.001 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 58 (19.1) | 246 (80.9) | 1.37 | 0.86-2.17 | 0.182 |
| Yes | 39 (24.4) | 121 (75.6) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 37 (29.8) | 87 (70.2) | | | |
| Gjoa Haven | 5 (7.6) | 61 (92.4) | 0.19 | 0.07-0.52 | <0.001 |
| Taloyoak | 23 (35.4) | 42 (64.6) | 1.29 | 0.68-2.44 | |
| Cape Dorset | 32 (15.3) | 177 (84.7) | 0.43 | 0.25-0.73 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.5 Bivariate association for selected variables with shortness of breath

| Variable+ | Shortness of Breath Yes n (%) | Shortness of Breath No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 88 (37.9) | 144 (62.1) | 1.35 | 0.93-1.96 | 0.109 |
| Carver | 105 (45.3) | 127 (54.7) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 80 (38.5) | 128 (61.5) | | | |
| Stone only | 34 (45.3) | 41 (54.7) | 1.33 | 0.79-2.26 | 0.354 |
| Stone & organic | 71 (45.2) | 86 (54.8) | 1.32 | 0.87-2.01 | |
| GENDER | | | | | |
| Female | 92 (46.2) | 107 (53.8) | 0.72 | 0.49-1.04 | 0.079 |
| Male | 101 (38.1) | 164 (61.9) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 55.2 (12.3) | 49.8 (11.6) | 1.04 | 1.02-1.06 | <0.001 |
| SMOKING STATUS | | | | | |
| Non-smoker | 12 (31.6) | 26 (68.4) | | | |
| Ex-smoker | 61 (43.9) | 78 (56.1) | 1.69 | 0.79-3.63 | 0.392 |
| Current smoker | 120 (41.8) | 167 (58.2) | 1.56 | 0.76-3.21 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 22.0 (22.2) | 15.4 (14.4) | 1.02 | 1.01-1.04 | <0.001 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 125 (41.1) | 179 (58.9) | 1.06 | 0.72-1.56 | 0.774 |
| Yes | 68 (42.5) | 92 (57.5) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 3 (50.8) | 61 (49.2) | | | |
| Gjoa Haven | 24 (36.4) | 42 (63.6) | 0.55 | 0.30-1.02 | 0.082 |
| Taloyoak | 28 (43.1) | 37 (56.9) | 0.73 | 0.40-1.34 | |
| Cape Dorset | 78 (37.3) | 131 (62.7) | 0.58 | 0.37-0.90 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.6 Bivariate association for selected variables with wheeze (past 12 months, without a cold present)

| Variable+ | Shortness of Breath Yes n (%) | Shortness of Breath No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 43 (18.5) | 189 (81.5) | 1.15 | 0.73-1.81 | 0.559 |
| Carver | 48 (20.7) | 184 (79.3) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 36 (17.3) | 172 (82.7) | | | |
| Stone only | 12 (16.0) | 63 (84.0) | 0.91 | 0.45-1.86 | 0.303 |
| Stone & organic | 36 (22.9) | 121 (77.1) | 1.42 | 0.85-2.38 | |
| GENDER | | | | | |
| Female | 38 (19.1) | 161 (80.9) | 1.06 | 0.67-1.69 | 0.808 |
| Male | 53 (20.0) | 212 (80.0) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 53.8 (13.1) | 51.6 (11.9) | 1.02 | 0.99-1.03 | 0.118 |
| SMOKING STATUS | | | | | |
| Non-smoker | 5 (13.2) | 33 (86.8) | | | |
| Ex-smoker | 26 (18.7) | 113 (81.3) | 1.52 | 0.54-4.26 | 0.501 |
| Current smoker | 60 (20.9) | 227 (79.1) | 1.74 | 0.65-4.66 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 24.7 (26.7) | 16.5 (15.2) | 1.02 | 1.01-1.04 | 0.006 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 58 (19.1) | 246 (80.9) | 1.10 | 0.68-1.78 | 0.690 |
| Yes | 33 (20.6) | 127 (79.4) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 24 (19.4) | 100 (80.6) | | | |
| Gjoa Haven | 8 (12.1) | 58 (87.9) | 0.58 | 0.24-1.36 | 0.246 |
| Taloyoak | 17 (26.2) | 48 (73.8) | 1.48 | 0.73-3.00 | |
| Cape Dorset | 42 (20.1) | 167 (79.9) | 1.05 | 0.60-1.83 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.7 Bivariate association for selected variables with wheeze associated with chest tightness

| Variable+ | Wheeze & Chest Tightness Yes n (%) | No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 20 (8.6) | 212 (91.4) | 2.55 | 1.45-4.48 | 0.001 |
| Carver | 45 (19.4) | 187 (80.6) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 16 (7.7) | 192 (92.3) | | | |
| Stone only | 15 (20.0) | 60 (80.0) | 3.00 | 1.40-6.43 | 0.002 |
| Stone & organic | 30 (19.1) | 127 (80.9) | 2.83 | 1.48-5.41 | |
| GENDER | | | | | |
| Female | 25 (12.6) | 174 (87.4) | 1.24 | 0.72-2.12 | 0.437 |
| Male | 40 (15.1) | 225 (84.9) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 53.8 (13.1) | 51.8 (12.0) | 1.01 | 0.99-1.04 | 0.199 |
| SMOKING STATUS | | | | | |
| Non-smoker | 4 (10.5) | 34 (89.5) | | | |
| Ex-smoker | 19 (13.7) | 120 (86.3) | 1.35 | 0.43-4.22 | 0.783 |
| Current smoker | 42 (14.6) | 245 (85.4) | 1.46 | 0.49-4.32 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 24.2 (29.9) | 17.1 (15.5) | 1.02 | 1.00-1.03 | 0.065 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 43 (14.1) | 261 (85.9) | 0.97 | 0.56-1.68 | 0.907 |
| Yes | 22 (13.8) | 138 (86.3) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 18 (14.5) | 106 (85.5) | | | |
| Gjoa Haven | 4 (6.1) | 62 (93.9) | 0.38 | 0.12-1.17 | 0.224 |
| Taloyoak | 9 (13.8) | 56 (86.2) | 0.95 | 0.40-2.24 | |
| Cape Dorset | 34 (16.3) | 175 (83.7) | 1.14 | 0.62-2.13 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.8 Bivariate association for selected variables with chest tightness

| Variable+ | Chest Tightness Yes n (%) | Chest Tightness No n (%) | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| CARVING STATUS | | | | | |
| Non-Carver | 43 (18.5) | 189 (81.5) | | | |
| Carver | 63 (27.2) | 169 (72.8) | 1.64 | 1.06-2.54 | 0.027 |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 37 (17.8) | 171 (82.2) | | | |
| Stone only | 14 (18.7) | 61 (81.3) | 1.06 | 0.54-2.10 | 0.007 |
| Stone & organic | 49 (31.2) | 108 (68.8) | 2.10 | 1.28-3.42 | |
| GENDER | | | | | |
| Female | 49 (24.6) | 150 (75.4) | | | |
| Male | 57 (21.5) | 208 (78.5) | 0.84 | 0.54-1.30 | 0.429 |
| AGE¥ | | | | | |
| Mean (SD) | 52.9 (12.2) | 51.8 (12.2) | 1.01 | 0.99-1.03 | 0.399 |
| SMOKING STATUS | | | | | |
| Non-smoker | 4 (10.5) | 34 (89.5) | | | |
| Ex-smoker | 31 (22.3) | 108 (77.7) | 2.43 | 0.80-7.37 | 0.144 |
| Current smoker | 71 (24.7) | 216 (75.3) | 2.78 | 0.96-8.11 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 20.3 (16.2) | 17.5 (18.9) | 1.01 | 0.99-1.02 | 0.161 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 67 (22.0) | 237 (78.0) | | | |
| Yes | 39 (24.4) | 121 (75.6) | 1.14 | 0.73-1.79 | 0.569 |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 41 (33.1) | 83 (66.9) | | | |
| Gjoa Haven | 10 (15.2) | 56 (84.8) | 0.36 | 0.17-0.78 | 0.004 |
| Taloyoak | 18 (27.7) | 47 (72.3) | 0.78 | 0.40-1.50 | |
| Cape Dorset | 37 (17.7) | 172 (82.3) | 0.44 | 0.26-0.73 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.9 Bivariate association for selected variables with attacks of wheeze with shortness of breath

| Variable+ | Wheeze & Shortness of Breath | | OR | 95% CI | p-value* |
|---|---|---|---|---|---|
| | Yes n (%) | No n (%) | | | |
| CARVING STATUS | | | | | |
| Non-Carver | 26 (11.2) | 206 (88.8) | 1.85 | 1.10-3.13 | 0.020 |
| Carver | 44 (19.0) | 188 (81.0) | | | |
| CARVING MEDIA (n=440) | | | | | |
| Non-carver | 23 (11.1) | 185 (88.9) | | | |
| Stone only | 9 (12.0) | 66 (88.0) | 1.10 | 0.48-2.49 | 0.009 |
| Stone & organic | 35 (22.3) | 122 (77.7) | 2.31 | 1.30-4.10 | |
| GENDER | | | | | |
| Female | 37 (18.6) | 163 (81.4) | 0.62 | 0.37-1.04 | 0.067 |
| Male | 33 (12.5) | 232 (87.5) | | | |
| AGE¥ | | | | | |
| Mean (SD) | 56.3 (12.8) | 51.3 (11.9) | 1.03 | 1.01-1.06 | 0.001 |
| SMOKING STATUS | | | | | |
| Non-smoker | 3 (7.9) | 35 (92.1) | | | |
| Ex-smoker | 21 (15.1) | 118 (84.9) | 2.08 | 0.59-7.37 | 0.420 |
| Current smoker | 46 (16.0% | 241 (84.0) | 2.23 | 0.66-7.55 | |
| CIGARETTE PACK-YEARS | | | | | |
| Mean (SD) | 23.1 (28.0) | 17.2 (15.9) | 1.01 | 1.00-1.03 | 0.094 |
| HISTORY OF TUBERCULOSIS | | | | | |
| No | 39 (12.8) | 265 (87.2) | 1.63 | 0.97-2.74 | 0.061 |
| Yes | 31 (19.4) | 129 (80.6) | | | |
| COMMUNITY OF RESIDENCE | | | | | |
| Baker Lake | 26 (21.0) | 98 (79.0) | | | |
| Gjoa Haven | 3 (4.5) | 63 (95.5) | 0.18 | 0.05-0.62 | 0.028 |
| Taloyoak | 10 (15.4) | 55 (84.6) | 0.69 | 0.31-1.53 | |
| Cape Dorset | 31 (14.8) | 178 (85.2) | 0.66 | 0.37-1.17 | |

+N for each variable is equal to 464, unless otherwise indicated

* p-value based on Pearson's chi-square statistic, unless otherwise indicated

¥Variable is continuous, therefore means are presented rather than proportions, p-value is based on independent t-test statistic

Table 6.10 Logistic regression model – usual cough

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.057 | 0.229 | 1.06 | 0.68-1.66 | 0.807 |
| Age | -0.001 | 0.010 | 0.99 | 0.98-1.02 | 0.947 |
| Gender (males) | -0.108 | 0.235 | 0.90 | 0.57-1.42 | 0.647 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.002 |
| Moderate (9-20 pack-years) | 0.288 | 0.282 | 1.33 | 0.77-2.32 | 0.307 |
| Heavy (21+ pack-years) | 0.950 | 0.284 | 2.59 | 1.48-4.51 | 0.001 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.002 |
| Gjoa Haven | -1.773 | 0.473 | 0.17 | 0.07-0.43 | <0.001 |
| Taloyoak | -0.131 | 0.333 | 0.88 | 0.46-1.68 | 0.694 |
| Cape Dorset | -0.456 | 0.249 | 0.63 | 0.39-1.03 | 0.067 |
| Constant | -0.905 | 0.572 | | | 0.114 |

Number of observations = 464
Likelihood ratio = 554.144-519.755=34.389
Df=8, p-value<0.001

Table 6.11 Logistic regression model – chronic cough

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | -0.059 | 0.282 | 0.94 | 0.54-1.64 | 0.833 |
| Age | 0.018 | 0.011 | 1.02 | 0.96-1.04 | 0.124 |
| Gender (males) | 0.264 | 0.291 | 1.30 | 0.74-2.30 | 0.365 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | <0.001 |
| Moderate (9-20 pack-years) | 0.963 | 0.415 | 2.62 | 1.16-5.91 | 0.020 |
| Heavy (21+ pack-years) | 1.592 | 0.405 | 4.91 | 2.22-10.87 | <0.001 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.027 |
| Gjoa Haven | -1.699 | 0.644 | 0.18 | 0.05-0.65 | 0.008 |
| Taloyoak | 0.285 | 0.390 | 1.33 | 0.62-2.85 | 0.465 |
| Cape Dorset | -0.229 | 0.308 | 0.80 | 0.44-1.46 | 0.458 |
| Constant | -3.509 | 0.746 | 0.03 | | <0.001 |

Number of observations = 464
Likelihood ratio = 413.801-373.962 = 39.839
Df=8, p-value<0.001

Table 6.12 Logistic regression model – usual phlegm

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.365 | 0.234 | 1.44 | 0.91-2.28 | 0.119 |
| Age | 0.030 | 0.010 | 1.03 | 1.01-1.05 | 0.002 |
| Gender (males) | -0.233 | 0.240 | 0.79 | 0.49-1.27 | 0.332 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.020 |
| Moderate (9-20 pack-years) | 0.285 | 0.288 | 1.33 | 0.76-2.34 | 0.321 |
| Heavy (21+ pack-years) | 0.786 | 0.288 | 2.19 | 1.25-3.86 | 0.006 |
| Community of residence: | | | | | |
| Baker Lake | | | | | <0.001 |
| Gjoa Haven | -1.773 | 0.419 | 0.17 | 0.08-0.39 | <0.001 |
| Taloyoak | 0.103 | 0.260 | 1.11 | 0.59-2.10 | 0.751 |
| Cape Dorset | -1.186 | 0.260 | 0.31 | 0.18-0.51 | <0.001 |
| Constant | -2.199 | 0.586 | 0.11 | - | <0.001 |

Number of observations = 464
Likelihood ratio = 569.899-498.209 = 71.690
Df=8, p-value<0.001

Table 6.13 Logistic regression model – chronic phlegm

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.348 | 0.261 | 1.42 | 0.85-2.36 | 0.182 |
| Age | 0.024 | 0.011 | 1.02 | 1.01-1.05 | 0.024 |
| Gender (males) | -0.171 | 0.266 | 0.84 | 0.50-1.42 | 0.520 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.001 |
| Moderate (9-20 pack-years) | 0.674 | 0.349 | 1.96 | 0.99-3.88 | 0.053 |
| Heavy (21+ pack-years) | 1.302 | 0.342 | 3.68 | 1.88-7.18 | <0.001 |
| Community of residence: | | | | | |
| Baker Lake | | | | | <0.001 |
| Gjoa Haven | -1.686 | 0.522 | 0.18 | 0.07-0.52 | 0.001 |
| Taloyoak | 0.428 | 0.348 | 1.53 | 0.78-3.03 | 0.218 |
| Cape Dorset | -0.843 | 0.290 | 0.43 | 0.24-0.76 | 0.004 |
| Constant | -3.021 | 0.674 | 0.05 | | <0.001 |

Number of observations = 464
Likelihood ratio = 475.784-418.761 = 57.023
Df=8, p-value<0.001

Table 6.14 Logistic regression model – shortness of breath

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.290 | 0.212 | 1.34 | 0.88-2.02 | 0.171 |
| Age | 0.028 | 0.009 | 1.03 | 1.01-1.05 | 0.002 |
| Gender (males) | -0.503 | 0.221 | 0.61 | 0.39-0.93 | 0.023 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.006 |
| Moderate (9-20 pack-years) | 0.446 | 0.252 | 1.56 | 0.95-2.56 | 0.076 |
| Heavy (21+ pack-years) | 0.840 | 0.261 | 2.32 | 1.39-3.87 | 0.001 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.156 |
| Gjoa Haven | -0.487 | 0.331 | 0.61 | 0.32-1.18 | 0.141 |
| Taloyoak | -0.185 | 0.325 | 0.83 | 0.44-1.57 | 0.570 |
| Cape Dorset | -0.517 | 0.242 | 0.60 | 0.37-0.86 | 0.033 |
| Constant | -1.777 | 0.534 | 0.17 | | 0.001 |

Number of observations = 464
Likelihood ratio = 630.066-588.187 = 41.879
Df=8, p-value<0.001

Table 6.15 Logistic regression model – wheeze (past 12 months, without a cold present)

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.027 | 0.257 | 1.03 | 0.62-1.70 | 0.918 |
| Age | 0.007 | 0.011 | 1.01 | 0.99-1.03 | 0.524 |
| Gender (males) | -0.100 | 0.264 | 0.90 | 0.54-1.52 | 0.704 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.002 |
| Moderate (9-20 pack-years) | 0.463 | 0.335 | 1.59 | 0.82-3.06 | 0.167 |
| Heavy (21+ pack-years) | 1.111 | 0.330 | 3.04 | 1.59-5.81 | 0.001 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.196 |
| Gjoa Haven | -0.479 | 0.450 | 0.62 | 0.26-1.50 | 0.288 |
| Taloyoak | 0.536 | 0.375 | 1.71 | 0.82-3.57 | 0.153 |
| Cape Dorset | 0.101 | 0.295 | 1.11 | 0.62-1.97 | 0.731 |
| Constant | -2.397 | 0.659 | 0.09 | | <0.001 |

Number of observations = 464
Likelihood ratio = 459.339-439.517 = 19.822
Df=8, p-value=0.011

Table 6.16 Logistic regression model – wheeze associated with chest tightness

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.863 | 0.308 | 2.37 | 1.30-4.34 | 0.005 |
| Age | 0.006 | 0.012 | 1.01 | 0.98-1.03 | 0.610 |
| Gender (males) | -0.026 | 0.305 | 0.98 | 0.54-1.77 | 0.933 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.307 |
| Moderate (9-20 pack-years) | 0.276 | 0.373 | 1.32 | 0.64-2.74 | 0.459 |
| Heavy (21+ pack-years) | 0.567 | 0.373 | 1.76 | 0.85-3.66 | 0.128 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.284 |
| Gjoa Haven | -0.999 | 0.585 | 0.37 | 0.12-1.16 | 0.088 |
| Taloyoak | 0.017 | 0.454 | 1.02 | 0.42-2.48 | 0.969 |
| Cape Dorset | 0.084 | 0.327 | 1.09 | 0.57-2.07 | 0.796 |
| Constant | -2.889 | 0.757 | 0.06 | | <0.001 |

Number of observations = 464
Likelihood ratio = 375.951-356.227 = 19.724
Df=8, p-value=0.011

Table 6.17 Logistic regression model –chest tightness

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.679 | 0.248 | 1.97 | 1.21-3.21 | 0.006 |
| Age | -0.008 | 0.011 | 0.99 | 0.97-1.01 | 0.443 |
| Gender (males) | -0.486 | 0.252 | 0.62 | 0.38-1.01 | 0.053 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.052 |
| Moderate (9-20 pack-years) | 0.440 | 0.301 | 1.55 | 0.86-2.80 | 0.143 |
| Heavy (21+ pack-years) | 0.749 | 0.308 | 2.12 | 1.16-3.87 | 0.015 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.002 |
| Gjoa Haven | -0.943 | 0.403 | 0.39 | 0.18-0.86 | 0.019 |
| Taloyoak | -0.130 | 0.349 | 0.88 | 0.44-1.74 | 0.710 |
| Cape Dorset | -0.938 | 0.273 | 0.39 | 0.23-0.67 | 0.001 |
| Constant | -0.785 | 0.620 | 0.46 | | 0.205 |

Number of observations = 464
Likelihood ratio = 498.703-470.593 = 28.110
Df=8, p-value<0.001

Table 6.18 Logistic regression model –attacks of wheeze with shortness of breath

| Variable | β | SE | OR | 95% C.I. | Wald p-value |
|---|---|---|---|---|---|
| Stone Carving (yes) | 0.682 | 0.291 | 1.98 | 1.12-3.50 | 0.019 |
| Age | 0.026 | 0.012 | 1.03 | 1.00-1.05 | 0.025 |
| Gender (males) | -0.606 | 0.292 | 0.55 | 0.31-0.97 | 0.038 |
| Cigarette pack-years: | | | | | |
| Mild (0-8 pack-years) | | | | | 0.314 |
| Moderate (9-20 pack-years) | 0.472 | 0.359 | 1.60 | 0.79-3.24 | 0.189 |
| Heavy (21+ pack-years) | 0.506 | 0.362 | 1.66 | 0.82-3.37 | 0.163 |
| Community of residence: | | | | | |
| Baker Lake | | | | | 0.070 |
| Gjoa Haven | -1.661 | 0.641 | 0.19 | 0.05-0.68 | 0.010 |
| Taloyoak | -0.286 | 0.427 | 0.75 | 0.33-1.74 | 0.504 |
| Cape Dorset | -0.383 | 0.306 | 0.68 | 0.37-1.24 | 0.211 |
| Constant | -3.183 | 0.737 | 0.04 | | <0.001 |

Number of observations = 464
Likelihood ratio = 393.659-363.360 = 30.299
Df=8, p-value<0.001

Table 6.19 Odds ratios (95% confidence interval), symptoms in relation to carving media used, compared to non-carvers*

| Symptom | Stone only (n=75) | Stone and organic media (n=159) |
|---|---|---|
| Usual cough | 0.96 (0.49-1.89) | 1.11 (0.66-1.88) |
| Chronic cough | 0.65 (0.28-1.53) | 0.99 (0.53-1.85) |
| Usual phlegm | 0.94 (0.48-1.87) | 1.66 (1.02-2.70) |
| Chronic phlegm | 1.21 (0.56-2.61) | 1.57 (0.88-2.81) |
| Shortness of breath | 1.37 (0.76-2.48) | 1.22 (0.75-1.96) |
| Wheeze (last 12 months) | 0.86 (0.41-1.83) | 1.34 (0.76-2.35) |
| Wheeze with chest tightness | 2.79 (1.29-6.00) | 2.54 (1.32-4.91) |
| Chest tightness | 1.36 (0.66-2.80) | 2.44 (1.43-4.16) |
| Attacks of wheeze with SOB | 1.20 (0.51-2.85) | 2.66 (1.41-5.02) |

*Adjusted for age, gender, cigarette pack-years and community of residence

Table 6.20 Odds ratios (95% confidence intervals), symptoms in relation to years of carving, compared to non-carvers

| Symptom | < 10 yr (n=105) | 11-25 yr (n=61) | >25 yr (n=66) |
|---|---|---|---|
| Usual cough | 1.03 (0.58-1.83) | 1.00 (0.50-2.00) | 1.16 (0.58-2.33) |
| Chronic cough | 0.92 (0.46-1.86) | 0.83 (0.35-1.95) | 1.07 (0.48-2.38) |
| Usual phlegm | 1.13 (0.64-1.99) | 0.97 (0.49-1.94) | 2.37 (1.23-4.55) |
| Chronic phlegm | 0.93 (0.48-1.78) | 1.25 (0.57-2.56) | 2.15 (1.07-4.34) |
| Shortness of breath | 1.17 (0.70-1.94) | 1.18 (0.64-2.21) | 1.80 (0.96-3.39) |
| Wheeze (last 12 months) | 0.85 (0.46-1.57) | 0.61 (0.27-1.38) | 1.68 (0.89-3.21) |
| Wheeze with chest tightness | 2.05 (1.02-4.09) | 1.60 (0.67-3.83) | 4.61 (2.30-9.25) |
| Chest tightness | 1.72 (0.97-3.02) | 1.42 (0.71-2.85) | 2.17 (1.13-4.16) |
| Attacks of wheeze with SOB | 1.75 (0.87-3.53) | 1.73 (0.74-4.03) | 2.44 (1.12-5.32) |

Odds ratio adjusted for age, gender, community of residence and cigarette pack-years
SOB = shortness of breath

Table 6.21 Odds ratios (95% confidence intervals), symptoms in relation to number of pieces carved, compared to non-carvers

| Symptom | <100 pieces (n=102) | 101-1000 pieces (n=70) | >1000 pieces (n=60) |
|---|---|---|---|
| Usual cough | 0.95 (0.53-1.69) | 1.02 (0.53-1.97) | 1.38 (0.68-2.80) |
| Chronic cough | 0.68 (0.32-1.44) | 1.13 (0.53-2.43) | 1.21 (0.54-2.71) |
| Usual phlegm | 1.11 (0.63-1.98) | 1.46 (0.77-2.76) | 1.97 (0.99-3.87) |
| Chronic phlegm | 1.02 (0.54-1.95) | 1.24 (0.60-2.55) | 1.93 (0.94-3.97) |
| Shortness of breath | 1.25 (0.76-2.07) | 1.71 (0.97-3.05) | 0.73 (0.38-1.41) |
| Wheeze (last 12 months) | 0.66 (0.34-1.28) | 1.32 (0.69-2.55) | 1.24 (0.62-2.51) |
| Wheeze with chest tightness | 1.22 (0.56-2.66) | 3.01 (1.46-6.23) | 3.89 (1.85-8.18) |
| Chest tightness | 1.25 (0.69-2.26) | 3.51 (1.90-6.48) | 1.19 (0.57-2.49) |
| Attacks of wheeze with SOB | 1.75 (0.86-3.48) | 2.11 (0.98-4.55) | 2.08 (0.89-4.85) |

Odds ratio adjusted for age, gender, community of residence and cigarette pack-years
SOB = shortness of breath

# CHAPTER 7: LUNG FUNCTION

The purpose of this chapter is to describe the lung function of the study population. Parameters, described in chapter 4, are expressed as both raw values and as percent of predicted value derived from prediction equations (Crapo 1981). These prediction equations can be found in appendix G.

Comparisons of mean values (bivariate analysis) for the parameters are examined for potential predictor variables, including stone carving. Multivariate analyses are presented to identify the most significant predictors for the selected parameters, while controlling for other predictor variables.

## 7.1 Adult Inuit Lung Function

Of the study population, 391 individuals took part in spirometry testing. Based on American Thoracic Society recommendations (1989), only those individuals meeting both the acceptability and reproducibility criteria were included in the statistical analyses (outlined in chapter 4). In total, 330 individuals met these requirements, including 186 males and 144 females. Table 7.1 presents the physical characteristics and lung volumes/flow rates (unadjusted) for participants.

The mean age for the male participants was 49.6 years (range: 35-77 years). The mean height for the males was 164.5 cm (range: 147.0-191.0 cm), and the mean weight was 74.1 kg (range: 36.0-142.0 kg). For lung volumes of interest (unadjusted), the mean FVC measured 4.43 l (range: 2.12-7.19 l), and the mean $FEV_1$ measured 3.27 l (range: 1.19-5.88 l). The $FEV_1$/FVC ratio averaged 73.2% (range: 47.8-87.1%), and the mean $FEF_{25-75}$ measured 2.69 l/s (range: 0.40-6.42 l/s).

The mean age for the female participants was slightly older than the males at 52.3 years (range: 35-82 years). The mean height for the females was 153.3 cm (range: 137.0-168.0 cm), and the mean weight was 69.9 kg (range: 40.0-134.0 kg). For lung volumes of interest (unadjusted), the mean FVC measured 3.02 l (range: 1.3-4.94 l), and the mean $FEV_1$

measured 2.22 l (range: 0.60-3.93 l). The $FEV_1$/FVC ratio averaged 72.5% (range: 37.9-85.3%), and the mean $FEF_{25-75}$ measured 1.82 l/s (range: 0.21-4.58 l/s).

The contribution of height and age to lung volumes and flow rates is firmly established (ATS 1991). Spirometric parameters are best described in terms of linear regression equations, providing insight into the contribution height and age has on the parameter of interest. Table 7.2 presents regression equations for spirometric parameters of interest for the study population, presented separately for males and females. In both genders, as height increased, lung volumes and flow rates increased. In contrast, as age increased, lung volumes and flow rates decreased for all parameters. The coefficients for each variable presented in table 7.2 provide the amount of increase or decrease of the parameter of interest per one unit increase in the coefficient (i.e. height or age).

The percent of predicted values and their 95% confidence intervals calculated for the study participants are shown in table 7.3. For both males and females, the percent of predicted for FVC was high. Males had a mean FVC 106.3% of predicted (95% CI: 103.9-108.7%), and females had a mean FVC 107.5% of predicted (95% CI: 104.0-110.9%). However, the $FEV_1$ percent of predicted was lower than predicted, with males having a mean $FEV_1$ of 95.4% of predicted (95% CI: 92.6-98.2%), and females having a mean $FEV_1$ of 94.5% of predicted (95% CI: 90.8-98.2%). The percent of predicted $FEV_1$/FVC was lower, as was the $FEF_{25-75}$.

## 7.2 Lung Function Comparisons between Carvers and Non-carvers

### 7.2.1 Bivariate Analysis

The mean values of lung function parameters were compared for carvers and non-carvers. In addition, selected variables that were of biological relevance, or noted in the literature were examined in relation to lung function parameters.

Table 7.4 shows a comparison of mean FVC values for selected variables. The mean FVC for carvers was 3.86 l (SD 1.09), which was not statistically different from non-carvers, with a mean FVC of 3.76 l (SD 1.10) (p=0.385).

As expected, gender, age and height had significantly different means for their categories. Males had a significantly larger FVCs than females ($p<0.001$), and increasing age categories showed lower mean FVC values ($p<0.001$). Conversely, as height increase, mean values in FVC also increased ($p<0.001$).

Mean values across categories of smoking habits (both smoking status and cigarette pack-years) were significantly different ($p=0.003$ and 0.006 respectively). Those who were current smokers, or who smoked more than 21 cigarette pack-years showed lower mean FVC values compared to the other categories for each variable. Notably, ex-smokers showed a slightly higher mean FVC value than non-smokers.

When examining history of tuberculosis, it was found that the mean FVC for those reporting a history was 3.55 l (SD 1.08), which differed significantly from those without a history of tuberculosis, with a mean FVC of 3.97 (SD 1.08) ($p=0.001$). Means between communities of residence were also compared, and found to be statistically different ($p=0.001$). Gjoa Haven had a mean FVC of 4.31 l (SD 1.02), Taloyoak 3.95 l (SD 1.29), Cape Dorset 3.74 l (SD 1.02), and Baker Lake 3.58 l (SD 1.09).

The bivariate analysis of forced expiratory volume in one second ($FEV_1$) was quite similar to that of forced vital capacity (FVC). Table 7.5 presents the comparison of mean $FEV_1$ values for selected variables. The mean $FEV_1$ for carvers was 2.81 l (SD 0.93), which was not statistically different from non-carvers, with a mean $FEV_1$ of 2.82 l (SD 0.93) ($p=0.875$).

As expected, gender, age and height had significantly different means for their categories. Males had a significantly larger $FEV_1$ than females ($p<0.001$), and increasing age categories showed a lower mean $FEV_1$ value ($p<0.001$). Conversely, as height increases, mean values in $FEV_1$ also increased ($p<0.001$).

Mean values across categories of smoking habits (both smoking status and cigarette pack-years) were significantly different ($p=0.008$ and $p<0.001$, respectively). Notably, mean values for smoking status categories showed both current smokers and ex-smokers had slightly higher mean $FEV_1$ values than non-smokers.

When examining history of tuberculosis, it was found that the mean $FEV_1$ for those reporting a history was 2.56 l (SD 0.87), which differed significantly from those without a history of tuberculosis, with a mean $FEV_1$ of 2.96 (SD 0.93) ($p<0.001$). Means between communities of residence were also compared, and found to be statistically different ($p<0.001$). Gjoa Haven had a mean $FEV_1$ of 3.32 l (SD 0.89), Taloyoak 2.99 l (SD 1.13), Cape Dorset 2.70 l (SD 0.82), and Baker Lake 2.63 l (SD 0.92).

The bivariate analyses for the $FEV_1$/FVC ratio show slightly different results compared to the FVC and $FEV_1$. The mean $FEV_1$/FVC for carvers was 71.58% (SD 8.27), which is statistically different from non-carvers with a mean $FEV_1$/FVC of 74.28% (SD 7.22) ($p=0.002$).

No significant difference was found between males and females ($p=0.437$), nor between categories of height ($p=0.134$). Means for age categories significantly decreased with increasing age ($p<0.001$).

Non-smokers had a mean $FEV_1$/FVC of 75.63% (SD 4.38), whereas ex-smokers had a mean of 71.14% (SD 8.62), and current smokers 73.32% (SD 7.74). The differences were found to be significant ($p=0.019$). Categories of cigarette-pack years had significantly differing means ($p<0.001$), showing a decrease in $FEV_1$/FVC as cigarette pack-years increased.

When examining history of tuberculosis, it was found that the mean $FEV_1$/FVC for those reporting a history was 71.55% (SD 7.06), which differed significantly from those without a history of tuberculosis, with a mean $FEV_1$/FVC of 73.65% (SD 7.97) ($p=0.019$). Means between communities of residence were also compared, and found to be statistically different ($p=0.003$). Gjoa Haven had a mean $FEV_1$/FVC of 76.32% (SD 6.88), Taloyoak 73.47% (SD 8.43), Cape Dorset 71.74% (SD 7.07), and Baker Lake 72.47% (SD 8.94).

For the $FEF_{25-75}$, carvers had a mean flow rate of 2.20 l/s (SD 1.19), which was not significantly lower than non-carvers (mean = 2.43 l/s, SD 1.20) ($p=0.081$).

As expected, gender, age and height had significantly different means for their categories. Males had a significantly larger $FEF_{25-75}$ than females ($p<0.001$), and increasing age categories showed a lower mean $FEF_{25-75}$ ($p<0.001$). Conversely, as height increased, mean values in $FEF_{25-75}$ also increased ($p<0.001$).

Non-smokers had a mean $FEF_{25-75}$ of 2.20 l/s (SD 1.02), whereas ex-smokers had a mean of 2.04 l/s (SD 1.22), and current smokers 2.43 l/s (SD 1.19). The differences were found to be significant ($p=0.031$). Categories of cigarette-pack years had significantly differing means ($p<0.001$), showing a decrease in $FEF_{25-75}$ as cigarette pack-years increased.

When examining history of tuberculosis, it was found that the mean $FEF_{25-75}$ for those reporting a history was 1.97 l/s (SD 1.03), which differed significantly from those without a history of tuberculosis, with a mean $FEF_{25-75}$ of 2.51 l/s (SD 1.24) ($p<0.001$). Means between communities of residence were also compared, and found to be statistically different ($p<0.001$). Gjoa Haven had a mean $FEF_{25-75}$ of 3.06 l/s (SD 1.34), Taloyoak 2.53 l/s (SD 1.39), Cape Dorset 2.07 l/s (SD 0.99), and Baker Lake 2.17 l/s (SD 1.16).

### 7.2.2 Multivariate Analysis

Multivariate analysis was performed for the four outcomes of interest to compare means while controlling for other factors. Differences in the means are discussed below in millilitres, as opposed to litres. Analysis of covariance was conducted separately for males and females to take in account gender differences, including the differences in distribution of height and age between males and females. The significance (p-value) of covariates in the models are also presented

Table 7.8 lists the adjusted means (in litres) and 95% confidence intervals for male carvers and non-carvers. Carvers showed a mean FVC 62 ml lower than non-carvers, however this finding was non-significant ($p=0.566$). Carvers showed a mean $FEV_1$ 66 ml lower than non-carvers, which was also non-significant ($p=0.470$). For the $FEV_1$/FVC ratio, the mean adjusted percent for carvers was 74.12% (95% CI: 72.83-75.40%), which was not significantly different from non-carvers at 74.31% (95% CI: 72.77-75.84%) ($p=0.844$).

Additionally, Carvers showed a mean $FEF_{25-75}$ 50 ml/s lower than non-carvers, which was also non-significant (p=0.729).

Table 7.9 lists the adjusted means (in litres) and 95% confidence intervals for female carvers and non-carvers. Carvers showed a mean FVC 17 ml lower than non-carvers, however this finding was non-significant (p=0.858). Carvers showed a mean $FEV_1$ 60 ml lower than non-carvers, which was also non-significant (p=0.483). For the $FEV_1$/FVC ratio, the mean adjusted percent for carvers was 71.85% (95% CI: 69.49-74.22%), which was not significantly different from non-carvers at 73.38% (95% CI: 71.46-75.31%) (p=0.269). Additionally, Carvers showed a mean $FEF_{25-75}$ 199 ml/s lower than non-carvers, which was also non-significant (p=0.130).

Table 7.10 shows the same multivariate results comparing spirometric parameters between carvers and non-carvers, but as percent of predicted.

Multivariate analysis was not conducted for types of media used (i.e. stone only vs. stone plus organic media). For three of the parameters of interest, this variable was not significant in the bivariate analysis. For $FEV_1$/FVC, this variable was significant in the bivariate analysis, but the difference was noted between non-carvers and the two carving categories as opposed to a difference in means between the carving categories.

### 7.2.3 Exposure-response

As with analysis of symptoms (section 6.4), exposure groups were created to assess whether lung function was associated with the number of years of carving, as well as the number of pieces of art produced over a career.

The number of spirometry participants in each category for pieces of art carved is listed below:

1) Non-carvers: 159
2) Less than 100 pieces: 75

3) Between 100 and 1000 pieces: 48
4) More than 1000 pieces: 48

The number of spirometry participants in each category for years of carving is listed below:

1) Non-carvers: 159
2) Less than 10 years: 79
3) Between 10 and 25 years: 48
4) More than 25 years: 44

Table 7.11 presents the adjusted means and 95% confidence intervals for the parameters of interest, based on the categories for pieces of art carved. No significant patters emerged for the parameters, however, the values tended to be lowest in the category of carving more than 1000 pieces, but not significantly. The exception is the $FEV_1/FVC$ ratio, in which the $FEV_1/FVC$ significantly decreased as the number of pieces carved increases ($p=0.009$).

Table 7.12 presents the adjusted means and 95% confidence intervals for the parameters of interest, based on the categories for years of carving. No significant patters emerged for the parameters, with the exception of the $FEV_1/FVC$. The $FEV_1/FVC$ decreased as the number of pieces carved increased, however, not significantly ($p=0.391$).

Table 7.1 Physical characteristics and lung volumes/flow rates (unadjusted) of Inuit from Nunavut (N=330)

| Age | N | Height (cm ± SD) | Weight (kg ± SD) | $FEV_1$ (l ± SD) | FVC (l ± SD) | $FEV_1$/ FVC (% ± SD) | $FEF_{25-75}$ (l/s ± SD) |
|---|---|---|---|---|---|---|---|
| ***Males*** | | | | | | | |
| 35-44 | 75 | 165.3 (5.7) | 74.1 (17.5) | 3.76 (0.54) | 4.88 (0.67) | 77.1 (4.9) | 3.43 (1.03) |
| 45-54 | 57 | 164.7 (6.3) | 73.7 (13.0) | 3.32 (0.79) | 4.54 (0.86) | 72.4 (6.7) | 2.59 (1.18) |
| 55-64 | 34 | 163.4 (6.7) | 73.0 (15.8) | 2.58 (0.70) | 3.75 (0.75) | 68.0 (9.1) | 1.76 (0.88) |
| 65-88 | 20 | 162.8 (5.7) | 77.6 (13.7) | 2.48 (0.58) | 3.54 (0.63) | 69.5 (7.6) | 1.72 (0.84) |
| ***Females*** | | | | | | | |
| 35-44 | 49 | 155.1 (5.1) | 66.6 (15.1) | 2.70 (0.54) | 3.55 (0.61) | 75.8 (6.2) | 2.42 (0.87) |
| 45-54 | 31 | 153.8 (7.0) | 69.6 (17.2) | 2.26 (0.59) | 3.09 (0.67) | 72.6 (6.6) | 1.80 (0.85) |
| 55-64 | 45 | 151.0 (4.7) | 73.7 (20.6) | 1.96 (0.45) | 2.69 (0.53) | 72.9 (7.3) | 1.56 (0.71) |
| 65-88 | 19 | 152.0 (6.4) | 70.2 (14.0) | 1.52 (0.74) | 2.34 (0.93) | 62.7 (10.9) | 0.90 (0.67) |

Table 7.2 Regression equations for spirometric parameters in Inuit males and females

| Parameter | n | r* | Coefficients | | | |
|---|---|---|---|---|---|---|
| | | | Constant | Height (cm) | Age (years) | SEE ⊥ |
| Males (n=186) | | | | | | |
| FVC (l) | 186 | 0.682 | -2.759 | 0.0567 | -0.0432 | 0.6584 |
| $FEV_1$ (l) | 186 | 0.688 | -1.443 | 0.0421 | -0.0445 | 0.6019 |
| $FEV_1$/FVC (%) | 186 | 0.462 | 89.5 | | -0.3300 | 6.6900 |
| $FEF_{25-75}$ (l/s) | 186 | 0.594 | 0.569 | 0.0323 | -0.0647 | 1.0049 |
| Females (n=144) | | | | | | |
| FVC (l) | 144 | 0.715 | -3.280 | 0.0528 | -0.0341 | 0.5499 |
| $FEV_1$ (l) | 144 | 0.716 | -1.924 | 0.0385 | -0.0334 | 0.4808 |
| $FEV_1$/FVC (%) | 144 | 0.449 | 89.9 | | -0.3300 | 7.4770 |
| $FEF_{25-75}$ (l/s) | 144 | 0.661 | 0.115 | 0.0266 | -0.0453 | 0.7470 |

⊥ SEE = standard error of estimate; r* = correlation coefficient

Table 7.3 Measured Inuit spirometry values compared to Crapo (1981) prediction equations

| Parameter | n | Inuit measured values | Predicted values using Caucasian equations | Inuit data as a percent of Caucasian predicted values* |
|---|---|---|---|---|
| Males | | | | |
| FVC (l) | 186 | 4.43 ± 0.90 | 4.16 ± 0.46 | 106.25 (103.85 – 108.65) |
| $FEV_1$ (l) | 186 | 3.27 ± 0.82 | 3.41 ± 0.39 | 95.41 (92.64 – 98.19) |
| $FEV_1$/FVC (%) | 186 | 73.18 ± 7.53 | 80.91 ± 1.69 | 90.40 (89.13 – 91.68) |
| $FEF_{25-75}$ (l/s) | 186 | 2.69 ± 1.24 | 3.60 ± 0.44 | 73.10 (68.75 – 77.44) |
| Females | | | | |
| FVC (l) | 144 | 3.02 ± 0.78 | 2.80 ± 0.43 | 107.45 (104.01 – 110.89) |
| $FEV_1$ (l) | 144 | 2.22 ± 0.68 | 2.32 ± 0.39 | 94.50 (90.84 – 98.17) |
| $FEV_1$/FVC (%) | 144 | 72.49 ± 8.34 | 82.46 ± 2.76 | 87.87 (86.31 – 89.42) |
| $FEF_{25-75}$ (l/s) | 144 | 1.82 ± 0.94 | 2.64 ± 0.55 | 67.32 (62.40 – 72.23) |

Data presented as mean±SD with 95% confidence interval in parentheses.
* predicted Caucasian values from Crapo et al. (1981), 95% confidence interval for the mean value calculated using percent of predicted.

Table 7.4 Comparison of mean FVC (l) values for selected variables

| Variable | FVC (l) Mean (SD) | p-value |
|---|---|---|
| CARVING STATUS | | |
| Non-Carver (n=171) | 3.76 (1.10) | 0.385* |
| Carver (n=159) | 3.86 (1.09) | |
| CARVING MEDIA | | |
| Non-carver (n=142) | 3.72 (1.10) | 0.001+ |
| Stone only (n=58) | 3.81 (1.13) | |
| Stone & organic (n=113) | 3.89 (1.08) | |
| GENDER | | |
| Female (n=144) | 3.02 (0.78) | <0.001* |
| Male (n=186) | 4.43 (0.90) | |
| AGE | | |
| 35-45 years (n=132) | 4.388 (0.937) | <0.001+ |
| 46-60 years (n=123) | 3.738 (1.005) | |
| 61-88 years (n=75) | 2.925 (0.775) | |
| HEIGHT | | |
| 137-156 cm (n=123) | 2.930 (0.752) | <0.001+ |
| 157-164 cm (n=109) | 3.949 (0.803) | |
| 165-191 cm (n=98) | 4.771 (0.849) | |
| SMOKING STATUS | | |
| Non-smoker (n=23) | 3.329 (1.171) | 0.003+ |
| Ex-smoker (n=91) | 3.600 (1.178) | |
| Current smoker (n=216) | 3.956 (1.028) | |
| CIGARETTE PACK-YEARS | | |
| 0-8 pack-years (n=90) | 3.717 (1.169) | 0.006+ |
| 9-20 pack-years (n=126) | 4.053 (1.070) | |
| 21- 92.5 pack-years (n=114) | 3.625 (1.029) | |
| HISTORY OF TUBERCULOSIS | | |
| No (n=208) | 3.970 (1.082) | 0.001* |
| Yes (n=122) | 3.547 (1.078) | |
| COMMUNITY OF RESIDENCE | | |
| Baker Lake (n=90) | 3.582 (1.093) | 0.001+ |
| Gjoa Haven (n=53) | 4.309 (1.016) | |
| Taloyoak (n=39) | 3.952 (1.291) | |
| Cape Dorset (n=148) | 3.740 (1.022) | |

*p-value is based on independent t-test statistic

+p-value based on one-way analysis of variance

Table 7.5 Comparison of mean $FEV_1$ (l) values for selected variables

| Variable | $FEV_1$ (l) Mean (SD) | p-value |
|---|---|---|
| CARVING STATUS | | |
| Non-Carver (n=171) | 2.821 (0.925) | 0.875* |
| Carver (n=159) | 2.805 (0.934) | |
| CARVING MEDIA | | |
| Non-carver (n=142) | 2.791 (0.920) | 0.814+ |
| Stone only (n=58) | 2.743 (0.935) | |
| Stone & organic (n=113) | 2.837 (0.935) | |
| GENDER | | |
| Female (n=144) | 2.217 (0.684) | <0.001* |
| Male (n=186) | 3.274 (0.825) | |
| AGE | | |
| 35-45 years (n=132) | 3.356 (0.775) | <0.001+ |
| 46-60 years (n=123) | 2.723 (0.816) | |
| 61-88 years (n=75) | 2.004 (0.684) | |
| HEIGHT | | |
| 137-156 cm (n=123) | 2.147 (0.673) | <0.001+ |
| 157-164 cm (n=109) | 2.893 (0.754) | |
| 165-191 cm (n=98) | 3.560 (0.765) | |
| SMOKING STATUS | | |
| Non-smoker (n=23) | 2.539 (0.947) | 0.008+ |
| Ex-smoker (n=91) | 2.613 (1.027) | |
| Current smoker (n=216) | 2.926 (0.865) | |
| CIGARETTE PACK-YEARS | | |
| 0-8 pack-years (n=90) | 2.846 (0.991) | <0.001+ |
| 9-20 pack-years (n=126) | 3.040 (0.896) | |
| 21- 92.5 pack-years (n=114) | 2.535 (0.843) | |
| HISTORY OF TUBERCULOSIS | | |
| No (n=208) | 2.960 (0.934) | <0.001* |
| Yes (n=122) | 2.562 (0.866) | |
| COMMUNITY OF RESIDENCE | | |
| Baker Lake (n=90) | 2.629 (0.924) | <0.001+ |
| Gjoa Haven (n=53) | 3.315 (0.885) | |
| Taloyoak (n=39) | 2.996 (1.132) | |
| Cape Dorset (n=148) | 2.704 (0.821) | |

*p-value is based on independent t-test statistic

+p-value based on one-way analysis of variance

Table 7.6 Comparison of mean $FEV_1/FVC$ (%) values for selected variables

| Variable | $FEV_1/FVC$ (%) Mean (SD) | p-value |
|---|---|---|
| CARVING STATUS | | |
| Non-Carver (n=171) | 74.28 (7.22) | 0.002* |
| Carver (n=159) | 71.58 (8.27) | |
| CARVING MEDIA | | |
| Non-carver (n=142) | 74.29 (7.40) | 0.009+ |
| Stone only (n=58) | 71.14 (7.71) | |
| Stone & organic (n=113) | 71.81 (8.57) | |
| GENDER | | |
| Female (n=144) | 72.49 (8.34) | 0.437* |
| Male (n=186) | 73.16 (7.53) | |
| AGE | | |
| 35-45 years (n=132) | 76.33 (5.60) | <0.001+ |
| 46-60 years (n=123) | 72.30 (7.12) | |
| 61-88 years (n=75) | 67.76 (9.44) | |
| HEIGHT | | |
| 137-156 cm (n=123) | 72.35 (8.39) | 0.134+ |
| 157-164 cm (n=109) | 72.27 (8.13) | |
| 165-191 cm (n=98) | 74.22 (6.80) | |
| SMOKING STATUS | | |
| Non-smoker (n=23) | 75.63 (4.38) | 0.019+ |
| Ex-smoker (n=91) | 71.14 (8.62) | |
| Current smoker (n=216) | 73.32 (7.74) | |
| CIGARETTE PACK-YEARS | | |
| 0-8 pack-years (n=90) | 75.89 (6.57) | <0.001+ |
| 9-20 pack-years (n=126) | 74.27 (7.09) | |
| 21- 92.5 pack-years (n=114) | 68.97 (8.17) | |
| HISTORY OF TUBERCULOSIS | | |
| No (n=208) | 73.65 (7.97) | 0.019* |
| Yes (n=122) | 71.55 (7.60) | |
| COMMUNITY OF RESIDENCE | | |
| Baker Lake (n=90) | 72.47 (8.94) | 0.003+ |
| Gjoa Haven (n=53) | 76.32 (6.88) | |
| Taloyoak (n=39) | 73.47 (8.43) | |
| Cape Dorset (n=148) | 71.74 (7.07) | |

*p-value is based on independent t-test statistic

+p-value based on one-way analysis of variance

Table 7.7 Comparison of mean $FEF_{25-75}$ (l/s) values for selected variables

| Variable | $FEF_{25-75}$ (l/s) Mean (SD) | p-value |
|---|---|---|
| CARVING STATUS | | |
| Non-Carver (n=171) | 2.427 (1.197) | 0.081* |
| Carver (n=159) | 2.197 (1.190) | |
| CARVING MEDIA | | |
| Non-carver (n=142) | 2.418 (1.198) | 0.189+ |
| Stone only (n=58) | 2.090 (1.179) | |
| Stone & organic (n=113) | 2.252 (1.198) | |
| GENDER | | |
| Female (n=144) | 1.818 (0.937) | <0.001* |
| Male (n=186) | 2.687 (1.242) | |
| AGE | | |
| 35-45 years (n=132) | 3.024 (1.108) | <0.001+ |
| 46-60 years (n=123) | 2.127 (1.034) | |
| 61-88 years (n=75) | 1.344 (0.731) | |
| HEIGHT | | |
| 137-156 cm (n=123) | 1.757 (0.962) | <0.001+ |
| 157-164 cm (n=109) | 2.320 (1.093) | |
| 165-191 cm (n=98) | 2.985 (1.235) | |
| SMOKING STATUS | | |
| Non-smoker (n=23) | 2.198 (1.015) | 0.031+ |
| Ex-smoker (n=91) | 2.043 (1.224) | |
| Current smoker (n=216) | 2.431 (1.190) | |
| CIGARETTE PACK-YEARS | | |
| 0-8 pack-years (n=90) | 2.604 (1.284) | <0.001+ |
| 9-20 pack-years (n=126) | 2.577 (1.134) | |
| 21- 92.5 pack-years (n=114) | 1.777 (1.012) | |
| HISTORY OF TUBERCULOSIS | | |
| No (n=208) | 2.508 (1.243) | <0.001* |
| Yes (n=122) | 1.966 (1.034) | |
| COMMUNITY OF RESIDENCE | | |
| Baker Lake (n=90) | 2.167 (1.164) | <0.001+ |
| Gjoa Haven (n=53) | 3.058 (1.337) | |
| Taloyoak (n=39) | 2.526 (1.394) | |
| Cape Dorset (n=148) | 2.067 (0.986) | |

*p-value is based on independent t-test statistic

+p-value based on one-way analysis of variance

Table 7.8 Multivariate analyses of selected spirometric parameters, with adjusted means for male carvers and non-carvers

| | FVC (l) | $FEV_1$ (l) | $FEV_1$/FVC (%) | $FEF_{25-75}$ (l/s) |
|---|---|---|---|---|
| Adjusted* means (mean, 95% CI): | | | | |
| Non-carvers (n=68) | 4.47 (4.30-4.64) | 3.36 (3.22-3.51) | 74.31 (72.77-75.84) | 2.86 (2.64-3.09) |
| Carvers (n=118) | 4.40 (4.40-4.55) | 3.30 (3.18-3.42) | 74.12 (72.83-75.40) | 2.81 (2.63-3.00) |
| Significance of variables in model (p-value): | | | | |
| Carving status | 0.566 | 0.470 | 0.844 | 0.729 |
| Community of residence | 0.085 | 0.002 | 0.000 | 0.000 |
| History of Tb | 0.287 | 0.115 | 0.107 | 0.061 |
| Cigarette pack-years | 0.183 | 0.006 | 0.000 | 0.000 |
| Age | 0.000 | 0.000 | 0.000 | 0.000 |
| Height | 0.000 | 0.000 | - | 0.009 |
| $r^2$ | 0.509 | 0.582 | 0.430 | 0.546 |

* evaluated at age = 49.57 and height = 164.47

Table 7.9 Multivariate analyses of selected spirometric parameters, with adjusted means for female carvers and non-carvers

| | FVC (l) | $FEV_1$ (l) | $FEV_1$/FVC (%) | $FEF_{25-75}$ (l/s) |
|---|---|---|---|---|
| Adjusted* means (mean, 95% CI): | | | | |
| Non-carvers (n=91) | 3.09 (2.96-3.23) | 2.29 (2.17-2.41) | 73.38 (71.46-75.31) | 2.00 (1.82-2.18) |
| Carvers (n=53) | 3.07 (2.91-3.24) | 2.23 (2.09-2.38) | 71.85 (69.49-74.22) | 1.80 (1.57-2.02) |
| Significance of variables in model (p-value): | | | | |
| Carving status | 0.858 | 0.483 | 0.269 | 0.130 |
| Community of residence | 0.001 | 0.002 | 0.513 | 0.002 |
| History of Tb | 0.020 | 0.091 | 0.662 | 0.525 |
| Cigarette pack-years | 0.515 | 0.130 | 0.015 | 0.014 |
| Age | 0.000 | 0.000 | 0.000 | 0.000 |
| Height | 0.000 | 0.000 | - | 0.001 |
| $r^2$ | 0.590 | 0.594 | 0.275 | 0.494 |

* evaluated at age = 52.32 and height = 153.14

Table 7.10 Adjusted* mean and 95% CI presented as percent of predicted (Crapo 1981) spirometric values for carvers and non-carvers

| Spirometric parameter | Non-carvers (n=159) | Carvers (n=171) | p-value |
|---|---|---|---|
| Males (n=186): | | | |
| FVC (%) | 106.9 (102.8-110.9) | 105.7 (102.3-109.1) | 0.655 |
| $FEV_1$ (%) | 97.5 (93.2-101.9) | 96.1 (92.4-99.7) | 0.590 |
| $FEV_1$/FVC (%) | 91.8 (89.8-93.7) | 91.6 (89.9-93.1) | 0.867 |
| $FEF_{25-75}$ (%) | 77.1 (70.9-83.4) | 76.6 (71.4-81.8) | 0.889 |
| Females (n=144): | | | |
| FVC (%) | 110.4 (105.4-115.4) | 110.6 (104.4-116.8) | 0.965 |
| $FEV_1$ (%) | 98.0 (92.7-103.3) | 96.2 (89.6-102.8) | 0.637 |
| $FEV_1$/FVC (%) | 89.0 (86.7-91.4) | 87.0 (84.0-89.9) | 0.237 |
| $FEF_{25-75}$ (%) | 73.9 (66.9-80.8) | 66.6 (58.1-75.2) | 0.150 |

* males evaluated at age=49.59, height=164.47. Females evaluated at age=52.32, height=153.14. Variables included in model: age, height, community of residence, history of tuberculosis and cigarette pack-years.

Table 7.11 Adjusted* mean (95% CI) of selected spirometric parameters for pieces of art carved over a career

| | Non-carvers (n=159) | <100 pieces (n=75) | 100-1000 pieces (n=48) | > 1000 pieces (n=48) | p-value |
|---|---|---|---|---|---|
| FVC (l) | 3.81 (3.70-3.91) | 3.74 (3.59-3.88) | 3.88 (3.70-4.07) | 3.75 (3.57-3.93) | 0.571 |
| $FEV_1$ (l) | 2.86 (2.77-2.95) | 2.81 (2.68-2.93) | 2.91 (2.75-3.07) | 2.71 (2.55-2.87) | 0.231 |
| $FEV_1$/FVC (%) | 74.29 (73.18-75.41) | 74.47 (72.89-76.06) | 73.80 (71.80-75.79) | 70.68 (68.68-72.68) | 0.009 |
| $FEF_{25-75}$ (l/s) | 2.47 (2.33-2.61) | 2.39 (2.20-2.59) | 2.50 (2.26-2.75) | 2.19 (1.95-2.44) | 0.202 |

*evaluated at age=50.78, height=159.52. Age, gender, height, community of residence, history of tuberculosis and cigarette pack-years entered into model.

Table 7.12 Adjusted* mean (95% CI) of selected spirometric parameters for years of carving

| | Non-carvers (n=159) | < 10 years (n=79) | 10-25 years (n=48) | > 25 years (n=44) | p-value |
|---|---|---|---|---|---|
| FVC (l) | 3.81 (3.71-3.91) | 3.72 (3.58-3.86) | 3.87 (3.69-4.06) | 3.82 (3.62-4.01) | 0.498 |
| $FEV_1$ (l) | 2.86 (2.77-2.95) | 2.78 (2.66-2.90) | 2.86 (2.709-3.02) | 2.81 (2.65-2.98) | 0.726 |
| $FEV_1$/FVC (%) | 74.24 (73.11-75.37) | 73.90 (72.35-75.45) | 72.92 (70.89-74.95) | 72.40 (70.25-74.56) | 0.391 |
| $FEF_{25-75}$ (l/s) | 2.46 (2.33-2.60) | 2.39 (2.20-2.58) | 2.26 (2.04-2.53) | 2.42 (2.16-2.68) | 0.628 |

*evaluated at age=50.78, height=159.52. Age, gender, height, community of residence, history of tuberculosis and cigarette pack-years entered into model.

# CHAPTER 8: CHEST RADIOGRAPHS

The purpose of this chapter is to present findings from the examination of chest radiographs for the study population. The focus of the radiographs was to note any abnormalities that are consistent with pneumoconiosis. Due to the small number of positive results, case reports for the abnormalities noted are presented in a descriptive format.

## 8.1 Quality of Chest Radiographs

Of the 464 participants in the study, 437 chest radiographs (94.2%) were made available for interpretation. The criteria for accepting a reading for analysis was to have both readers label a particular radiograph as good, acceptable or poor (outlined in chapter 4). If either, or both, of the readers labelled a reading as "unreadable", then the results were not used in the analysis.

Table 8.1 shows the breakdown and comparison of quality ratings for the two primary readers. The measurement of agreement between readers for classifying quality produced a kappa of 0.248, which shows fair agreement.

The number of radiographs that were considered to be "good," was quite low for the participants (n=10, 2.3% in total agreed upon between the two readers). However, a larger number were classified by both readers as "acceptable" (n=108, 24.7% in total). Although just 6.4% (n=28) were jointly classified as "unreadable", in total, 83 (19.0%) radiographs were not used in the analysis, as one or both labelled the radiograph as "unreadable". Therefore, 354 chest radiographs were considered for interpretation (76.3% of the total study population). Reader 2 was less likely than reader 1 to call films good, poor or unreadable, and more likely to call them acceptable.

Table 8.1 Comparison of ratings of the quality of x-rays between reader 1 and reader 2

| | | Quality rating reader 1 | | | | |
|---|---|---|---|---|---|---|
| | | Good | Acceptable | Poor | Unreadable | Total |
| Quality rating reader 2 | Good | 10 | 16 | 4 | 1 | 31 |
| | Acceptable | 42 | 108 | 84 | 18 | 252 |
| | Poor | 6 | 19 | 65 | 24 | 114 |
| | Unreadable | 1 | 2 | 9 | 28 | 40 |
| | Total | 59 | 145 | 162 | 71 | 437 |

N=437, kappa=0.248, p<0.001

## 8.2 Parenchymal Abnormalities – Descriptive Results

Each reader blindly examined the radiographs, documenting any parenchymal abnormalities that were consistent with pneumoconiosis. Of the 326 radiographs that were considered to have acceptable quality for interpretation, reader 1 documented 1 case of possible abnormalities (0.3%), and reader 2 documented 2 cases (0.6%). A third reader examined 59 of the radiographs that needed further clarification. Of the 59 radiographs read, reader 3 noted 13 possible cases (4.0% of total readable radiographs) in which parenchymal abnormalities were in keeping with pneumoconiosis. In looking at agreement between readers, only one case was agreed upon by at least two of the three readers as exhibiting parenchymal abnormalities. This case is described below:

Parenchymal abnormalities were noted for a male participant, age 62 years from Cape Dorset. Small, irregular opacities were noted with varying widths ranging up to 3 mm, located in the right and left lower zones. The grade of profusion was given as 2/1. Table 8.2 shows the results of the corresponding spirometry test, showing both the actual values and the percent of predicted (using Crapo 1981).

Table 8.2 Spirometry parameters (observed and percent of predicted) for participant displaying signs of parenchymal abnormalities consistent with pneumoconiosis

| Parameter | Observed vale | Percent of predicted |
|---|---|---|
| FVC (l) | 3.913 | 107.4% |
| $FEV_1$ (l) | 2.875 | 97.6% |
| $FEV_1$/FVC (%) | 74.1 | 92.1% |
| $FEF_{25-75}$ (l/s) | 2.201 | 71.5% |

This participant indicated symptoms of usual and chronic cough, usual and chronic phlegm, shortness of breath, and attacks of wheezing with shortness of breath. He did not report symptoms of wheezing in the past twelve months, chest tightness or wheezing associated with chest tightness. There was no indication of current illness and no history of asthma, tuberculosis, or attacks of bronchitis.

He was a current smoker, with 30 cigarette pack-years of exposure. He had previously been occupationally exposed to paint for a period of three years.

The participant was a carver, having done so for 49 years. He had carved approximately 500 pieces over the course of his career, of varying sizes. He used stones from a one hundred-mile radius of the community, and did not use organic media (ivory, antler or bone). He carved outdoors all seasons and power tools had been used for approximately one year. He used a mask only on occasion.

## 8.3 Pleural Abnormalities – Descriptive Results

Of the 326 radiographs that were considered to have acceptable quality for interpretation, reader 1 documented 6 cases of possible abnormalities (1.8%), and reader 2 documented 1 case (0.3%). A third reader examined 59 of the radiographs that may have needed further clarification. Of the 59 radiographs read, reader 3 noted no cases with pleural abnormalities. In looking at agreement between readers, only one case was agreed upon by at least two of the three readers as exhibiting pleural abnormalities. This case is described below:

Pleural abnormalities were noted for a male participant, age 61 years from Gjoa Haven.

Pleural thickening was noted at both the right and left costophrenic angles. Circumscribed plaques were noted on the right chest wall with a maximum width between 5 and 10 mm. The extent was noted as the total length equivalent to up to one quarter of one lateral chest wall. No pleural calcification was noted.

Table 8.3 shows the results of the corresponding spirometry test, showing both the actual values and the percent of predicted (using Crapo 1981).

Table 8.3 Spirometry parameters (observed and percent of predicted) for participant displaying signs of pleural abnormalities consistent with pneumoconiosis

| Parameter | Observed vale | Percent of predicted |
|---|---|---|
| FVC (l) | 4.217 | 117.6% |
| $FEV_1$ (l) | 2.125 | 90.1% |
| $FEV_1$/FVC (%) | 65.2 | 80.9% |
| $FEF_{25-75}$ (l/s) | 1.376 | 45.0% |

This participant indicated symptoms of shortness of breath, but no other respiratory symptoms. There was no indication of current illness and no history of asthma, tuberculosis, pneumonia, or attacks of bronchitis.

He was a current smoker, with 25 cigarette pack-years of exposure. He had no history of occupational exposure to dust, gases, or fumes.

He was a carver, having done so for two years, during which produced approximately 20 pieces of varying sizes. He used local stone and did not use organic media (ivory, antler or bone). He carved outdoors during summer (not an active carver in the winter) and power tools had not been used. He had never used a mask.

# CHAPTER 9: DISCUSSION

In this chapter, results of the study are summarized. A discussion of the agreement of the study findings with other similar occupational studies, possible explanations for observed differences, and the study's strengths and limitations are provided.

## 9.1 Stone Carvers

Stone carving in Inuit communities is a highly valued and unique occupation. Not only does each carver produce unique artworks, but the materials and methods vary as well. Most of the carving activities occurred in the open air, where the airborne dust could disperse widely. Nonetheless, from a sample of the participating carvers in the occupational hygiene investigation, respirable dust levels measured in the breathing zone varied from a mean of 0.9 $mg/m^3$ in partial shaping operations to a mean of 4.2 $mg/m^3$ in gross shaping operations. These levels are similar to other occupational groups, such as talc-producing workers with estimated mean dust exposure levels of 1.9 $mg/m^3$ (Wild et al 1995), and dolomite workers with estimated median dust exposure of 2.8 $mg/m^3$ (Selden et al 2001).

The dusts to which carvers were exposed to varied between and within carvers. A study completed in the Arctic revealed that the type of rock quarried for carving was of many varieties (McDermott 1992), including, serpentinites, marble, and steatite ("soapstone").

A feasibility study conducted in 1992 at various sites in the Northwest Territories also revealed that some samples analysed contained talc, chlorite, dolomite, tremolite, and at a few sites, chrysotile asbestos fibres and bundles. However, chrysotile was rare, and was not noted in any samples in the current study (Green, personal communications 2002).

## 9.2 Respiratory Symptoms

Because most of the dusts were inorganic, dust levels were moderate, and respiratory protection was not consistently used, symptoms suggestive of non-specific airway irritation (chronic bronchitis) were expected to be found in excess among the carvers (Morgan 1978).

In 1973, Higgins reviewed the published studies of chronic pulmonary disease of men engaged in dusty occupations. Almost all were cross-sectional, comparing dust-exposed and non-exposed workers. In almost all, there was higher prevalence of bronchitis in the former compared to the latter.

Most studies of dust in relation to chronic bronchitis have been done on workers not exposed to the dusts in the present investigation.

In this study, 17.7% of carvers reported chronic cough, not statistically different from the non-carvers (15.1%). Similarly, the prevalence of chronic phlegm in carvers was 24.1%, not significantly different from the prevalence in non-carvers (17.7%).

The relatively low odds ratios (overall) for cough and phlegm may have resulted from the high prevalence of smoking in this region. The estimate of 62% current smokers in the present study is consistent with other findings from this region (NWT Bureau of Statistics, Government of the Northwest Territories. Drug and Alcohol Survey: unpublished data, 1996). The presence of chronic phlegm, however, showed a graded response with years of carving.

Relatively increased odds ratios for symptoms suggestive of bronchial responsiveness were also unexpected, given the predominance of inorganic dust exposures. The excess of symptoms suggestive of bronchial responsiveness was explained, in part, by exposure to organic media such as ivory, antler, and bone.

Although not extensively studied, case reports have documented asthma-like symptoms in response to working with organic media such as ivory (Armstrong et al 1988) and bone (Diaz-Jara et al 2001; Patterson et al 1991).

Organic dusts from animals, vegetables, microbial, or chemical substances can act as antigens to trigger an immune response (Molina and Caillaud 1989). Exposure to organic dusts can produce a variety of respiratory effects after exposure, including airway inflammation, chronic bronchitis, asthma and chest tightness (Rylander 1998).

Studies investigating farm workers (Donham et al 1989) and workers in industries exposed to dusts such as cotton (Haglind and Rylander 1984; Schilling et al 1955) have documented reports of a subjective feeling of chest tightness. Byssinosis is the classic name given to a feeling of chest tightness, which gradually develops during the first day at work and improves during the week (Molina and Caillaud 1989). However, with continued dust exposure, chest tightness may extend to other days of the week.

Exposures to dusts from grain and flour have also been shown to produce similar respiratory symptoms. Prichard et al (1984) reported work-related chest symptoms in 176 bakers and 24 slicers and wrappers. Approximately 19% of the bakers reported work-related chest symptoms while none of the slicers or wrappers had chest complaints.

In addition to organic media exposure, materials used for polishing the carvings (including seal and walrus oil, corn oil, waxes, jewellery compounds and others) may be considered in relation to these symptoms.

Physical labour in a cold climate might also be considered. Previous reports have shown bronchial responsiveness during activity in low temperatures, but mainly for individuals suffering from asthma (Strauss et al, 1977; Koskela et al, 1994).

Asthma was not found statistically in excess within the carving group.

### 9.3 Lung Function

Ethnicity is known to play a significant role in determining pulmonary function measurements (Oscherwitz et al 1972; Wanger 1996). Such differences must be considered when interpreting pulmonary function tests.

A previous study, conducted by Rode and Shephard (1973), examined the pulmonary function of Inuit in the community of Igloolik NWT. Consistent with the current study, the investigators found that the FVC of healthy Inuit exceeded predicted values for "white" communities. Predicted values for $FEV_1$ also exceeded "white" values in the 1973 study. The $FEV_1$/FVC was somewhat below those predicted for Caucasians in both studies.

Larger than usual spirometric indices in costal Inuit have also been observed by others, although large variations have been observed between communities (Schaefer et al 1980; Beuadry 1968). A possible explanation for the relatively large lung volumes is body build. Anecdotal reports have suggested that costal Inuit have a large trunk/leg length ratio (Rowley 1963, Schaeffer and Hildes 1993). The lower predicted $FEV_1$/FVC may be explained, in part, by the high rate of cigarette smoking in this population.

After taking age, height and cigarette pack-years into account, no significant differences in lung function were noted between the carving and non-carving groups. There was a notable finding in this study when examining exposure-response for the ratio $FEV_1$/FVC, which showed a graded response in exposure categories for years of carving, and significantly so for pieces of art carved, independent of smoking.

Deficits of lung function, associated with increasing cumulative dust exposure have previously been reported among underground coalminers in the United Kingdom (Maclaren et al 1994). Reports from the United States suggest that deficits have also been found in drillers from opencast mines (Piacitelli et al 1990). In a study of Quebec chrysotile workers (Becklake et al 1972) it was shown that certain measurements of lung function changed progressively with increasing dust exposure both in non-smokers and in smokers. The $FEV_1$/FVC was minimally affected in the low exposure group, but a reduction was evident in the high exposure groups.

## 9.4 Chest Radiographs

The prevalence of abnormalities consistent with pneumoconiosis was quite low in the carving group (0.8%), and cannot be associated with dust exposure in any clear-cut way. As the prevalence was low, no analysis was conducted to test for associations with explanatory variables.

Other studies examining exposures to low levels of dust also found a low prevalence of abnormalities. Muir et al's (1989) population of underground hard-rock miners in Canada had a 1% rate of abnormality and Vermont granite workers a 0.7% rate (Graham et al 1991). Hughes et al's (1998) data evaluating the diatomaceous earth industry suggest that a cumulative exposure of 2.0 mg/m$^3$-year will lead to radiographic abnormalities from 1.4% of workers. In comparing this to a non-exposed population, Castellan et al (1985) examined blue-collar workers currently working in environments free from exposure to respiratory hazards. Small opacities of profusion 1/0 were identified in only 0.21% of the radiographs.

In contrast, many studies of occupations exposed to dust have a much higher prevalence of radiographic abnormalities, generally with higher levels of exposure. Harries (1970) examined men heavily exposed to mainly asbestos together with intermittently exposed workers from other trades in one the Royal Naval Dockyards. In men heavily exposed, 60% of those with over 30 years exposure and 17% of those with 10 to 30 years showed small opacities of category 1 or more. The corresponding figures for intermittently exposed workers were 4% and 4%, respectively.

## 9.5 Strengths and Limitations

This study possesses both strengths and limitations that should be taken into consideration for interpretation of results.

### 9.5.1 Strengths

*Community Involvement*

Community involvement is a key to success when conducting a study in the north. The individuals within the community that joined the research team provided many positive results. Locally trained interviewers, fluent in English and Inuktitut, helped minimise the effects of cultural differences, and increase the credibility of the study. Several designated contact individuals in each of the communities aided in the recruitment of participants and clarified missing information that allowed the study to operate within logistic constraints due to the research setting. The health centres also provided a great deal of support to the research team. The impact of this collaboration is evident from the study's high participation rate (83% for at least questionnaire participation).

*Interviewer-administered Questionnaires*

Interviewer -administered questionnaires allowed individuals who could not read or write to participate and complete the questionnaire, improving the generalisability of the study.

### 9.5.2 Limitations

*Cultural Differences and Logistics*

Although local individuals participated as part of the research team and information was available in both English and Inuktitut, cultural differences still could have impacted the study. For example, it was noted by the field researchers that certain terms were not easily understood, such as "chest tightness", which needed to be rephrased as "chest heaviness" as tightness was not associated as a feeling in the chest.

In addition, the concept of general health could have been interpreted differently. For example, to a great extent, it was noted that if the participant did not feel acutely ill at the time of the interview, then a current chronic condition might not have been reported as being present.

Logistical realities limit many studies conducted in northern Canada. Expenses for travel and lodging are high, limiting time available for fieldwork. Additionally, the availability of medical equipment and trained medical personnel in the communities varies, which could impact the quality of results obtained. For example, the majority of chest radiographs obtained were not of the highest quality, in many cases this resulted from the fact that they were duplicates of the originals. At total of 83 (19.0%) of the radiographs provided were not of sufficient quality to be used in the study. The comment most frequently made by the readers regarding the poor quality of the x-rays was that they were over-penetrated. This may have limited the ability to detect minor changes consistent with early pneumoconiosis. However, the lack of evidence of pneumoconiosis even in good or acceptable films argues against the likelihood that significant problems were missed.

*Cross-sectional Study Design*

Although a cross-sectional study design is useful for determining the prevalence of risk factors and the prevalence of outcomes for a defined population, it also serves as an important limitation to this study. Data about both the exposure and the presence or absence of outcomes were collected simultaneously. This creates problems in determining the temporal relationship of a presumed cause and effect.

*Interview Bias*

This study may have been subject to interview bias. Interviews took place in four separate communities, with an average of four interviewers in each location. Although equally trained and using a validated questionnaire containing mainly "yes" or "no" answers (Ferris 1978), interviewers may have differed in their data collection, thus leading to biased questionnaire data.

For example, one situation of interview bias was identified prior to analysis. Symptoms of rhinitis were not examined because some of the interviewers included reactions to cold air, whereas some interviewers did not present the question as including nasal symptoms in response to cold air.

*Self-reported Information – Recall*

Information was collected from participants by means of interview, and thus problems of recall existed. Participants may not have been able to correctly identify past illness or remember time frames, such as years of carving, or years of cigarette smoking. The irregularities of carving activities over time for many of the carvers may well have affected the accuracy of the descriptions of quantitative estimates of time periods, number of pieces, and carving practices. There is no reason to believe that this would have introduced bias, however, misclassification may have taken place. This type of problem generally results in an underestimate of the true risk of outcomes associated with the exposure (Gordis 1996).

Recall bias may have arisen if carvers (who were aware of the study objectives) overestimated their symptoms or illness. However, there was no indication that this occurred.

*Carving Exposure Classifications*

Carvers comprise a unique occupational group in that there is no specific practice, material, or tool that an artist consistently uses. Therefore, unlike many occupational settings, exposure estimates are very difficult to produce.

It is also difficult to develop groups of persons with similar exposures, and misclassification of a carver's exposure is quite likely. Uncertainty is inherent to all exposure assessment strategies and is caused by a large random variation in exposure over time and space. In general, this reduces the power of a study to detect an association between exposure and disease and can introduce bias into the exposure-response estimates (Armstrong 1990).

In addition, the types of stones the artists used, in addition to other materials prevents classification of exposure to any one type of material. The types of stones vary between quarries in Nunavut, and the importation of stones used for carving adds additional media variation.

*Healthy Worker Effect*

It is important to point out that the true impact to occupational dust exposure may have been obscured in this study because of a selection process. Selection out of a workforce because of respiratory ill health has been found in several groups working in dusty environments (Fox and Collier 1976; Broder et al 1985). Thus it may be that only persons with superior lung

function seek employment in such employment, causing a "healthy worker effect". If carvers had been adversely affected by dust, they may have given up carving. This would have diluted the effects of the exposure and muted exposure-response relationships.

## 9.6 Sample Size and Statistical Power

The Inuit population of the Eastern Arctic is relatively small. This resulted in some problems for statistical analysis, leading to imprecise estimates. Additionally, the low prevalence of certain participant characteristics resulted in small cell numbers and thus a limited degree of precision was achievable (wide confidence intervals).

Power describes how good the study is at correctly identifying a difference between means (or proportions) if in reality they are different. Using the computer software program PS: Power and Sample Size Calculations (Dupont & Plummer 1997), statistical power of select analyses was examined with the given sample size. Power is dependent on both the magnitude of the effect and size of the study population (Hennekens and Buring 1987).

Power is calculated as $1-\beta$, where $\beta$ is the probability of making a type II error ("false-negative"). This error refers to a mistaken failure to reject the null hypothesis when the alternative hypothesis is true and there is a real difference between study groups. The probability of making a type I error ("false-positive"), or $\alpha$, refers to the situation in which the null hypothesis is rejected when it is in fact true.

It is optimal to minimize both errors, however minimizing one comes at the expense of an increase in the probability of the other. Tables 7.1 and 7.2 list the resulting statistical power for selected analyses using the given sample size, standard deviations and difference of means or odds ratios at $\alpha = 0.05$.

Table 9.1 Statistical power of selected analyses, dichotomous variables

| Outcome | Odds ratio (95% confidence interval) | Power |
|---|---|---|
| Chronic cough | 1.21 (0.74-1.98) | 21.3% |
| Chronic phlegm | 1.48 (0.94-2.33) | 69.5% |

Table 9.2 Statistical power of selected analyses, continuous variables

| Outcome | Observed difference between means | Power |
|---|---|---|
| FVC | 0.105 l | 14.1% |
| $FEV_1$ | 0.016 l | 5.3% |

For many of the analyses performed, the statistical power was low, particularly for lung function, in detecting statistically significant differences between the carvers and non-carvers. An increase in sample size could provide more precise estimates in detecting differences between carvers and non-carvers. However, with the relatively small population in northern communities, inclusion of more study participants could have proved to be difficult. The $FEV_1$ is the measurement generally considered when determining impairment in lung function (Lapp 1998). The observed mean difference in $FEV_1$ between carvers and non-carvers is 16 ml, which may not be considered clinically important.

## 9.7 Conclusions

### 9.7.1 Summary of Findings

The findings of this study suggest that:

1) Carving practices within and between artists vary and precise estimates of dust exposure are difficult to obtain. However, the hygiene investigation suggested a generally low, although fluctuating, exposure to dust during carving. In addition, artists used power tools frequently (65% of carvers), that produce more dust and finer

particles (Yoshida 2001); with only a moderate usage of dust masks (58% of carvers). Because the average length of time using these tools is only 9 years, diseases such as the pneumoconiosis, that generally have a longer latency period (Morgan and Seaton 1995), may not be evident for years to come, if it is associated with carving at all.

2) Little evidence of abnormalities was noted in relation to mineral dust exposure. Symptoms suggestive of chronic bronchitis (chronic cough and chronic phlegm) were not noted to be reported statistically more often in carvers than in non-carvers. Lung function parameters, although lower in carvers, were also not found to reach significance. Finally, radiographic abnormalities consistent with pneumoconiosis were quite low and could not be associated with carving in a clear-cut way. The majority of the analyses conducted were found to have low power, and a larger sample size may have aided in detecting significant differences between carvers and non-carvers.

3) Symptoms suggestive of bronchial responsiveness were significantly more prevalent in carvers than non-carvers. This finding is associated with exposure to organic media used in carving, and warrants further examination.

4) Many factors associated with respiratory health (symptoms, lung function and radiographic abnormalities) in this study group are largely unknown/unexplained. During multivariate analysis, factors such as age, height, gender and smoking practices were significantly associated with the outcomes of interest. However, the contribution of these factors in explaining variation ($r^2$) was generally low.

### 9.7.2 Future Research

This was a unique study examining the respiratory health of Inuit stone carvers. As is the case in cross-sectional studies, this study was useful in determining respiratory health status by documenting the prevalence of respiratory abnormalities in the study group.

The significant prevalence of symptoms suggestive of bronchial responsiveness in carvers warrants further investigation. Materials used in the carving process other than stone may also be investigated. The use of organic media in carving was not quantified in this study, nor were the current practices of tool use concerning this media examined.

Because of the long latency period of many respiratory diseases and the relatively recent use of power tools, future investigations of respiratory health in carvers may be defensible. However, cost is certainly a factor for such undertakings. A longitudinal study would be necessary to check the effectiveness of interventions such as mask usage or changes in power tool usage.

Surveillance of different media from local quarries could be continued in order to document specific mineral exposures.

Education of carvers on the potential for respiratory health hazards should continue for stone carvers in Nunavut. The art of Inuit stone carving has evolved over centuries and will continue to change in the future, thus presenting different challenges in protection of respiratory health.

## REFERENCE LIST


1. SPSS. (10.0). 1999. Chicago, IL, SPSS Inc.
   Ref Type: Computer Program

2. Office Medic/Spiro Card Med Graphics. 2000. St. Paul, MN, Medical Graphics Corporation.
   Ref Type: Computer Program

3. Abboud RT,.Morton JW. Comparison of maximal mid-expiratory flow, flow volume curves, and nitrogen closing volumes in patients with mild airway obstruction. *Am.Rev.Respir.Dis.* 1975;**111**:405-17.

4. Algranti, E., Souza, E., and Filho, A. S. Correlations between radiology, respiratory symptoms and spirometry in active underground coal miners in Brazil. Abstract of Communications, VIIth International Pneumoconiosis Conference , 8. 1988. Pittsburgh,PA.
   Ref Type: Conference Proceeding

5. American Conference of Governmental Industrial Hygienists. Particle size - selective sampling of particulate air contaminants. Vincent, J. 1999. Cincinnati, OH, ACGIH.
   Ref Type: Report

6. American Thoracic Society. Standardization of Spirometry 1987 Update. *Respir.Care* 1987;**32**:1039-60.

7. American Thoracic Society. Lung Function Testing: Selection of Reference Values and Interpretative Strategies. *Am.Rev.Respir.Dis.* 1991;**144**:1202-18.

8. American Thoracic Society. Standardization of Spirometry 1994 Update. *Am.J Respir.Crit Care Med* 1995; **152**:1107-36.

9. Armstrong BG. The effects of measurement errors on relative risk regressions. *Am.J Epidemiol.* 1990;**132**:1176-84.

10. Armstrong RA, Neill P, Mossop RT. Asthma induced by ivory dust: a new occupational cause. *Thorax* 1988;**43**:737-8.

11. Avtsyn AP. [Notes of a wartime pathologist]. *Arkh.Patol.* 1985;**47**:19-29.

12. Baloyi, R. S. and Cullen, M. R. Prevalence of pneumoconiosis in Zimbabwes coal and hard rock mines. Abstract of Communications, VIIth International Pneumoconiosis Conference , 194. 1988. Pittsburgh,PA.
    Ref Type: Conference Proceeding

13. Banerji A, Bell A, Mills EL, McDonald J, Subbarao K, Stark G *et al.* Lower respiratory tract infections in Inuit infants on Baffin Island. *CMAJ.* 2001;**164**:1847-50.

14. Banks DE, Cheng YH, Weber SL, Ma JK. Strategies for the treatment of pneumoconiosis. *Occup.Med* 1993; **8**:205-32.

15. Banks DE, Parker JE. Occupational Lung Disease: An International Perspective. London, UK: Chapman & Hall Medical, 1998.

16. Banks DE, Wang ML, Lapp NL. Respiratory health effects of opencast coalmining: a cross sectional study of current workers. *Occup.Environ.Med* 1998;**55**:287-8.

17. Beaudry PH. Pulmonary function survey of the Canadian Eastern Arctic Eskimo. *Arch.Environ.Health* 1968;**17**:524-8.

18. Becklake MR, Fournier-Massey G, Rossiter CE, McDonald JC. Lung function in chrysotile asbestos mine and mill workers of Quebec. *Arch.Environ.Health* 1972;**24**:401-9.

19. Becklake MR. Chronic airflow limitation: its relationship to work in dusty occupations. *Chest* 1985;**88**:608-17.

20. Becklake MR. Occupational exposures: evidence for a causal association with chronic obstructive pulmonary disease. *Am.Rev.Respir.Dis.* 1989;**140**:S85-S91.

21. Becklake MR. The mineral dust diseases. *Tuber.Lung Dis.* 1992;**73**:13-20.

22. Benavides, R. Coal workers' pneumoconiosis and respiratory function in Chilean miners. Abstract of Communications, VIIth International Pneumoconiosis Conference , 144. 1988. Pittsburgh,PA.
Ref Type: Conference Proceeding

23. Bowerman RJ. Alaska Native cancer epidemiology in the Arctic. *Public Health* 1998;**112**:7-13.

24. Brandson LE. Carved from the Land. Altona, MB: Diocese of Churchill Hudson Bay, 1994.

25. Broder I, Corey P, Davies G, Hutcheon M, Mintz S, Inouye T *et al.* Longitudinal study of grain elevator and control workers with demonstration of healthy worker effect. *J Occup.Med* 1985;**27**:873-80.

26. Brody JA. Lower respiratory illness among Alaskan Eskimo children. *Arch.Environ.Health* 1965;**11**:620-3.

27. Burrows B. An overview of obstructive lung diseases. *Med Clin.North Am.* 1981;**65**:455-71.

28. Caillaud D,.Molina CL. [Obstructive pseudotumoral bronchial aspergillosis]. *Presse Med* 1987;**16**:174.

29. Castellan RM, Sanderson WT, Petersen MR. Prevalence of radiographic appearance of pneumoconiosis in an unexposed blue collar population. *Am.Rev.Respir.Dis.* 1985;**131**:684-6.

30. Cho, K. S., Lee, S. H., and Yun, I. M. Preliminary report on the progression of pneumoconiosis among Korean coal-face workers with special reference to anthracite exposure. Ann.Am Conf Gov Ind Hyg 14, 163-169. 1986.
Ref Type: Conference Proceeding

31. Churg A, Wright JL, Wiggs B, Pare PD, Lazar N. Small airways disease and mineral dust exposure. Prevalence, structure, and function. *Am.Rev.Respir.Dis.* 1985;**131**:139-43.

32. Copes R, Thomas D, Becklake MR. Temporal patterns of exposure and nonmalignant pulmonary abnormality in Quebec chrysotile workers. *Arch.Environ.Health* 1985;**40**:80-7.

33. Cotes JE, Chinn DJ, Reed JW. Lung function testing: methods and reference values for forced expiratory volume (FEV1) and transfer factor (TL). *Occup.Environ.Med* 1997;**54**:457-65.

34. Cowie RL. Pulmonary dysfunction in gold miners with reactive airways. *Br.J Ind.Med* 1989;**46**:873-6.

35. Cowie RL,.Mabena SK. Silicosis, chronic airflow limitation, and chronic bronchitis in South African gold miners. *Am.Rev.Respir.Dis.* 1991;**143**:80-4.

36. Crandall R. Inuit Art:A History. Jefferson,NC: McFarland, 2000.

37. Crapo RO, Morris AH, Gardner RM. Reference Spirometric Values Using Techniques and Equipment that meet ATS Recommendations. *Am.Rev.Respir.Dis.* 1981;**123**:659-64.

38. Daly LE, Bourke GJ. Interpretation and Uses of Medical Statistics. London, UK: Blackwell Science Ltd., 2000.

39. Department of Health and Social Services. Northwest Territories Health Status Report. The Chief Medical Officer of Health. 1999. Yellowknife, Government of the Northwest Territories.
Ref Type: Report

40. Diaz-Jara M, Kao A, Ordoqui E, Zubeldia JM, Baeza ML. Allergy to cow bone dust. *Allergy* 2001;**56**:1014-5.

41. Donham K, Haglind P, Peterson Y, Rylander R, Belin L. Environmental and health studies of farm workers in Swedish swine confinement buildings. *Br.J Ind.Med* 1989;**46**:31-7.

42. Dupont WD,.Plummer WD, Jr. Power and sample size calculations. A review and computer program. *Control Clin.Trials* 1990;**11**:116-28.

43. Eber D. Eskimo tales. *Natural History* 1977;**86**:126-9.

44. El Batawi M. Work-related diseases. *Nurs J Singapore* 1978;**18**:95-6.

45. el Batawi MA. Health problems of industrial workers in Egypt. *IMS.Ind.Med Surg.* 1972;**41**:18-23.

46. Enarson DA. Tuberculosis in Aboriginals in Canada. *Int.J Tuberc.Lung Dis.* 1998;**2**:S16-S22.

47. Federal, Provincial Territorial Advisory Committee on Population Health Canada. Report of the health of canadians. 1996. Ottawa, Health Canada.
Ref Type: Report

48. Ferris BG. Epidemiology Standardization Project (American Thoracic Society). *Am.Rev.Respir.Dis.* 1978;**118**:1-120.

49. Fletcher CM, Peto R, Tinker CM. A comparison of the assessment of simple bronchitis (chronic mucus hypersecretion) by measurements of sputum volume and by standardized questions on phlegm production. *Int.J Epidemiol.* 1974;**3**:315-9.

50. Fournier-Massey G,.Becklake MR. Pulmonary function profiles in Quebec asbestos workers. *Bull.Physiopathol.Respir.(Nancy.)* 1975;**11**:429-45.

51. Fox AJ,.Collier PF. Low mortality rates in industrial cohort studies due to selection for work and survival in the industry. *Br.J Prev.Med* 1976;**30**:225-30.

52. Glauser FL. Signs and symptoms in pulmonary medicine. Philadelphia: Lippincott, 1983.

53. Gordis L. Epidemiology. Philadelphia,PA: W.B. Saunders Company, 1996.

54. Government of Alberta. Occupational Health and Safety Act. 2002. Edmonton, Alberta Queens Printer.
Ref Type: Report

55. Graham WG, Ashikaga T, Hemenway D, Weaver S, O'Grady RV. Radiographic abnormalities in Vermont granite workers exposed to low levels of granite dust. *Chest* 1991;**100**:1507-14.

56. Graham WG, Vacek PM, Morgan WK, Muir DC, Sisco-Cheng B. Radiographic abnormalities in long-tenure Vermont granite workers and the permissible exposure limit for crystalline silica. *J Occup.Environ.Med* 2001;**43**:412-7.

57. Green, F., Hessel, P. A., Yoshida, K., and Cowie, R. L. Evaluation of Respiratory Hazards in Carvingstone Workers. Report to NHRDP on the Formulation Phase. 1993.
Ref Type: Report

58. Greenberg GN,.Dement JM. Exposure assessment and gender differences. *J Occup.Med* 1994;**36**:907-12.

59. Grzybowski S, Styblo K, Dorken E. Tuberculosis in Eskimos. *Tubercle.* 1976;**57**:S1-58.

60. Gupta P, Chaswal M, Saxena S. Ventilatory functions in stone quarry workers of Rajasthan. *Indian J Physiol Pharmacol.* 1999;**43**:496-500.

61. Gustavison S. Northern Rock: Contemporary Inuit Stone Sculpture. Kleinburg,ON: McMichael Canadian Art Collection, 1999.

62. Haglind P,.Rylander R. Exposure to cotton dust in an experimental cardroom. *Br.J Ind.Med* 1984;**41**:340-5.

63. Harless KW, Watanabe S, Renzetti AD, Jr. The acute effects of chrysotile asbestos exposure on lung function. *Environ.Res.* 1978;**16**:360-72.

64. Harries, P. G. The effects and control of diseases associated with exposure to asbestos in a naval dockyard. 141-278. 1970. London,UK.
Ref Type: Thesis/Dissertation

65. Hennekens CH, Buring JE. Epidemiology in Medicine. Boston,MA: Little, Brown and Company, 1987.

66. Herxheimer H,.Schaefer O. Letter: Asthma in Canadian Eskimos. *N.Engl.J Med* 1974;**291**:1419.

67. Hessel I. Inuit Art: An Introduction. Vancouver: Douglas and McIntyre, 1998.

68. Hessel PA, Sluis-Cremer GK, Hnizdo E. Case-control study of silicosis, silica exposure, and lung cancer in white South African gold miners. *Am.J Ind.Med* 1986;**10**:57-62.

69. Higgins IT, Oldham PD, Cochrane AL, Gilson JG. Respiratory symptoms and pulmonary disability in an industrial town: survey of a random sample of the population. *Br.Med.J* 1956;904-10.

70. Higgins IT. Chronic respiratory disease in mining communities. *Ann.N.Y.Acad.Sci.* 1972;**200** :197-210.

71. Hildes JA,.Schaefer O. The changing picture of neoplastic disease in the western and central Canadian Arctic (1950-1980). *Can.Med Assoc.J* 1984;**130**:25-32.

72. Hnizdo E. Combined effect of silica dust and tobacco smoking on mortality from chronic obstructive lung disease in gold miners. *Br.J Ind.Med* 1990;**47**:656-64.

73. Hnizdo E, Hessel PA, Sluis-Cremer GK. Chronic airflow limitation in South African gold miners. *Am.Rev.Respir.Dis.* 1991;**144**:1423-4.

74. Hoeppner VH,.Marciniuk DD. Tuberculosis in aboriginal Canadians. *Can.Respir.J* 2000;7:141-6.

75. Hosmer DW, Lemeshow S. Applied Logistic Regression. New York, NY: John Wiley & Sons, 1989.

76. Hughes JM, Weill H, Checkoway H, Jones RN, Henry MM, Heyer NJ *et al.* Radiographic evidence of silicosis risk in the diatomaceous earth industry. *Am.J Respir.Crit Care Med* 1998;**158**:807-14.

77. International Labour Organization. Guidelines for the use of ILO International Classification of Radiographs of Pneumoconioses. Geneva: 1980.

78. Irwig LM, du Toit RS, Sluis-Cremer GK, Solomon A, Thomas RG, Hamel PP *et al.* Risk of asbestosis in crocidolite and amosite mines in South Africa. *Ann.N.Y.Acad.Sci.* 1979;**330**:35-52.

79. Jackson JA, Bates RL. Glossary of Geology. Alexandria,VA: American Geological Institute, 1987.

80. Jain BL,.Patrick JM. Ventilatory function in Nigerian coal miners. *Br.J Ind.Med* 1981;**38**:275-80.

81. Jekel JF, Elmore JG, Katz DL. Epedemiology, Biostatistics and Preventitive Medicine. Philadelphia, PA: W.B Saunders Company, 1996.

82. Kagan E, Oghiso Y, Hartmann DP. The effects of chrysotile and crocidolite asbestos on the lower respiratory tract: analysis of bronchoalveolar lavage constituents. *Environ.Res.* 1983;**32**:382-97.

83. Karron RA, Singleton RJ, Bulkow L, Parkinson A, Kruse D, DeSmet I *et al.* Severe respiratory syncytial virus disease in Alaska native children. RSV Alaska Study Group. *J Infect.Dis.* 1999;**180**:41-9.

84. Kleinbaum DG, Kupper LL, Muller KE, Nizam A. Applied Regression Analysis and Other Multivariate Methods. Pacific Grove, CA: Brooks/Cole Publishing, 1998.

85. Korn RJ, Dockery DW, Speizer FE, Ware JH, Ferris BG, Jr. Occupational exposures and chronic respiratory symptoms. A population-based study. *Am.Rev.Respir.Dis.* 1987;**136**:298-304.

86. Koskela H, Tukiainen H, Kononoff A, Pekkarinen H. Effect of whole-body exposure to cold and wind on lung function in asthmatic patients. *Chest* 1994;**105**:1728-31.

87. Kreiss K, Greenberg LM, Kogut SJ, Lezotte DC, Irvin CG, Cherniack RM. Hard-rock mining exposures affect smokers and nonsmokers differently. Results of a community prevalence study. *Am.Rev.Respir.Dis.* 1989;**139**:1487-93.

88. Lapp NL, Morgan WK, Zaldivar G. Airways obstruction, coal mining, and disability. *Occup.Environ.Med* 1994;**51**:234-8.

89. Lebowitz MD. Occupational exposures in relation to symptomatology and lung function in a community population. *Environ.Res.* 1977;**14**:59-67.

90. Lebowitz MD. Multivariate analysis of smoking and other risk factors for obstructive lung diseases and related symptoms. *J Chronic.Dis.* 1982;**35**:751-8.

91. Lippmann M. Effects of fiber characteristics on lung deposition, retention, and disease. *Environ.Health Perspect.* 1990;**88**:311-7.

92. Lloyd-Davies, T. A. Report of the Survey of Respiratory Disease in Foundrymen. 1971. London,UK, Her Majesty's Stationery Office.
Ref Type: Report

93. Love RG, Miller BG, Groat SK, Hagen S, Cowie Ha, Johnston HA *et al.* Respiratory health effects of opencast colamining: a cross sectional study of current workers. *Occup.Environ.Med* 1997;**54**:416-23.

94. Maclaren, W. M., Miller, B. G., Hurley, J. F., and Love, R. G. Reference values for lung function decline in working coalminers. 1994. Edinburgh, Institute of Occupational Medicine.
Ref Type: Report

95. Manfreda J, Sidwall G, Maini K, West P, Cherniack RM. Respiratory abnormalities in employees of the hard rock mining industry. *Am.Rev.Respir.Dis.* 1982;**126**:629-34.

96. Marine WM, Gurr D, Jacobsen M. Clinically important respiratory effects of dust exposure and smoking in British coal miners. *Am.Rev.Respir.Dis.* 1988;**137**:106-12.

97. Maynard JE,.Hammes LM. A study of growth, morbidity and mortality among Eskimo infants of western Alaska. *Bull.World Health Organ* 1970;**42**:613-22.

98. McDermott G. Carvingstone occurences of the Northwest Territories. Yellowknife: NWT geology Division-NAP, 1992.

99. McDonald JC, Becklake MR, Fournier-Massey G, Rossiter CE. Respiratory symptoms in chrysotile asbestos mine and mill workers of Quebec. *Arch.Environ.Health* 1972;**24**:358-63.

100. Metadilogkul O, Ittiravivongs A, Limpakarnjanarat K, Rattanapornpan N, Pimiam S. Silicosis among mortar and pestle workers in northern Thailand: cross-sectional study. *J Med Assoc.Thai.* 1988;**71**:533-6.

101. Millar WJ. Smoking prevalence in the Canadian Arctic. *Arctic Med Res.* 1990;**49 Suppl 2**:23-8.

102. Miller AB,.Gaudette LA. Cancer of the respiratory system in Circumpolar Inuit. *Acta Oncol.* 1996;**35**:571-6.

103. Ministry of Public Health of P.R.China. Data collection of epidemiologic study on pneumoconioses in China (1949-1986). 16-49. 1992. Beijing, Publishing House of Beijing Medical University and Chinese Xiehe Medical University.
Ref Type: Report

104. Morgan WK. Industrial bronchitis. *Br.J Ind.Med* 1978;**35**:285-91.

105. Morgan WK, Seaton A. Occupational lung diseases. Philadelphia: Saunders, 1995.

106. Muir DC, Julian JA, Shannon HS, Verma DK, Sebestyen A, Bernholz CD. Silica exposure and silicosis among Ontario hardrock miners: III. Analysis and risk estimates. *Am.J Ind.Med* 1989;**16**:29-43.

107. Myers MG, Fomon SJ, Koontz FP, McGuinness GA, Lachenbruch PA, Hollingshead R. Respiratory and gastrointestinal illnesses in breast- and formula-fed infants. *Am.J Dis.Child* 1984;**138**:629-32.

108. Nejjari C, Tessier JF, Dartigues JF, Barberger-Gateau P, Letenneur L, Salamon R. The relationship between dyspnoea and main lifetime occupation in the elderly. *Int.J Epidemiol.* 1993;**22**:848-54.

109. Neuberger M. [Epidemiologic study of chronic respiratory tract diseases]. *Prax.Klin.Pneumol.* 1988;**42**:479-81.

110. Oscherwitz M, Edlavitch SA, Baker TR, Jarboe T. Differences in pulmonary functions in various racial groups. *Am.J Epidemiol.* 1972;**96**:319-27.

111. Oxman AD, Muir DC, Shannon HS, Stock SR, Hnizdo E, Lange HJ. Occupational dust exposure and chronic obstructive pulmonary disease. A systematic overview of the evidence. *Am.Rev.Respir.Dis.* 1993;**148**:38-48.

112. Patterson R, Ganz MA, Roberts M. Anaphylaxis and asthma in a scrimshander due to deer bone dust. *Ann.Allergy* 1991;**67**:529-32.

113. Pellant C. Rocks and Minerals. New York: Dorling Kindersley, 1992.

114. Piacitelli GM, Amandus HE, Dieffenbach A. Respirable dust exposures in U.S. surface coal mines (1982-1986). *Arch.Environ.Health* 1990;**45**:202-9.

115. Prichard MG, Ryan G, Musk AW. Wheat flour sensitisation and airways disease in urban bakers. *Br.J Ind.Med* 1984;**41**:450-4.

116. Rae, S., Walker, D. D., and Attfield, M. D. Chronic bronchitis and dust exposure in British coal mines. Walton, W. H. 883-894. 1971. London, UK, Unwin Brothers Ltd. Inhaled Particles III.
Ref Type: Conference Proceeding

117. Rode A,.Shephard RJ. Pulmonary function of Canadian Eskimos. *Scand.J Respir.Dis.* 1973;**54** :191-205.

118. Rogan JM, Attfield MD, Jacobsen M, Rae S, Walker DD, Walton WH. Role of dust in the working environment in development of chronic bronchitis in British coal miners. *Br.J Ind.Med* 1973;**30**:217-26.

119. Roggli VL. Human disease consequences of fiber exposures: a review of human lung pathology and fiber burden data. *Environ.Health Perspect.* 1990;**88**:295-303.

120. Rohl AN, Langer AM, Selikoff IJ, Tordini A, Klimentidis R, Bowes DR *et al.* Consumer talcums and powders: mineral and chemical characterization. *J Toxicol.Environ.Health* 1976;**2**:255-84.

121. Ross M, Skinner HCW, Frandel C. Asbestos and other fibrous materials: mieneralogy, crystal chemistry, and health effects. Nw York: Oxford University Press, 1988.

122. Rossiter CE, Bristol LJ, Cartier PH, Gilson JG, Grainger TR, Sluis-Cremer GK *et al.* Radiographic changes in chrysotile asbestos mine and mill workers of Quebec. *Arch.Environ.Health* 1972;**24**:388-400.

123. Rothman KJ, Greenland S. Modern Epidemiology. Philadelphia,PA: Lippincott Williams & Wilkins, 1998.

124. Rowley GW. What are Eskimos? *North* 1963;**10**:12-8.

125. Rylander R. [The link between exposure to mould and respiratory problems is incontrovertible]. *Lakartidningen* 1998;**95**:2445-6.

126. Schaefer, O. Characteristics of the Canadian Eskimo population. 1967. Inuvik, NT, Read at the summer school of frontier medicine.
Ref Type: Generic

127. Schaefer O. The changing health picture in the Canadian North. *Can.J Ophthalmol.* 1973;**8**:196-204.

128. Schaefer O, Eaton RD, Timmermans FJ, Hildes JA. Respiratory function impairment and cardiopulmonary consequences in long-time residents of the Canadian Arctic. *Can.Med Assoc.J* 1980;**123**:997-1004.

129. Schaefer O, Hildes JA. Health Problems and Health Care Delivery in the Canadian North. Winnipeg, MB: University of Manitoba, 1993.

130. Schilling RS, Hughes JPW, Dingwall-Fordyce I, Gilson JG. An epidemiological study of byssinosis among Lancashire cotton workers. *Br.J Ind.Med* 1955;**12**:217-27.

131. Selden AI, Berg NP, Lundgren EA, Hillerdal G, Wik NG, Ohlson CG *et al.* Exposure to tremolite asbestos and respiratory health in Swedish dolomite workers. *Occup.Environ.Med* 2001;**58**:670-7.

132. Senthilselvan A,.Habbick BF. Increased asthma hospitalizations among registered Indian children and adults in Saskatchewan, 1970-1989. *J Clin.Epidemiol.* 1995;**48**:1277-83.

133. Singleton R, Morris A, Redding G, Poll J, Holck P, Martinez P *et al.* Bronchiectasis in Alaska Native children: causes and clinical courses. *Pediatr.Pulmonol.* 2000;**29**:182-7.

134. Sinha, J. K. Progression of coal workers' pneumoconiosis in a coal mine. Abstract of Communications, VIIth International Pneumoconiosis Conference , 12. 1988. Pittsburgh,PA.
Ref Type: Conference Proceeding

135. Solomon SK. Radiology of Occupational Chest Disease. New York, NY: Springer-Verlag, 1989.

136. Soutar CA,.Hurley JF. Relation between dust exposure and lung function in miners and ex-miners. *Br.J Ind.Med* 1986;**43**:307-20.

137. Speizer FE, Ferris B, Jr., Bishop YM, Spengler J. Respiratory disease rates and pulmonary function in children associated with NO2 exposure. *Am.Rev.Respir.Dis.* 1980;**121** :3-10.

138. Statistics Canada. Profiles, Canadian population: selected statistics. 1996. Ottawa. Ref Type: Report

139. Stebbings JH, Jr. Chronic respiratory disease among nonsmokers in Hagerstown, Maryland. I. Design of the study and prevalence of symptoms. *Environ.Res.* 1971;**4**:146-62.

140. Stout JW, Sullivan M, Liu LL, Grossman DC. Asthma prevalence among American Indian and Alaska Native children. *Public Health Rep* 1999;**114**:257-61.

141. Strauss RH, McFadden ER, Jr., Ingram RH, Jr., Jaeger JJ. Enhancement of exercise-induced asthma by cold air. *N.Engl.J Med* 1977;**297**:743-7.

142. Tager IB, Segal MR, Speizer FE, Weiss ST. The natural history of forced expiratory volumes. Effect of cigarette smoking and respiratory symptoms. *Am.Rev.Respir.Dis.* 1988;**138**:837-49.

143. US Department of the Interior, Bureau of Mines. Stones. 1980. US Government Printing Office.
Ref Type: Report

144. Waldram JB, Herring DA, Young TK. Aboriginal Health in Canada: Historical, Cultural, and Epidemiological Perspectives. Toronto,ON: Universoty of Toronto Press, 1995.

145. Wanger J. Pulmonary Function Testing: A Practical Approach. Baltimore, MD: Williams & Wilkins, 1996.

146. Wegman DH, Peters JM, Boundy MG, Smith TJ. Evaluation of respiratory effects in miners and millers exposed to talc free of asbestos and silica. *Br.J Ind.Med* 1982;**39**:233-8.

147. Weill H, Ziskind MM, Waggenspack C, Rossiter CE. Lung function consequences of dust exposure in asbestos cement manufacturing plants. *Arch.Environ.Health* 1975;**30**:88-97.

148. Wild P, Refregier M, Auburtin G, Carton B, Moulin JJ. Survey of the respiratory health of the workers of a talc producing factory. *Occup.Environ.Med* 1995;**52**:470-7.

149. Wiles FJ,.Faure MH. Chronic obstructive lung disease in gold miners. *Inhaled.Part* 1975;**4 Pt 2**:727-35.

150. Wilt JL, Banks DE, Weissman DN, Parker JE, Vallyathan V, Castranova V *et al.* Reduction of lung dust burden in pneumoconiosis by whole-lung lavage. *J Occup.Environ.Med* 1996;**38**:619-24.

151. Wright JL, Tron V, Wiggs B, Churg A. Cigarette smoke potentiates asbestos-induced airflow abnormalities. *Exp.Lung Res.* 1988;**14**:537-48.

152. Yoshida, K. Evaluation of Respiratory Hazards in Carvingstone Workers. Industrial Hygiene Investigation Report. 2001.
Ref Type: Report

153. Young TK. Epidemiology and control of chronic diseases in circumpolar Eskimo/Inuit populations. *Arctic Med Res.* 1986;**42**:25-47.

154. Young TK, Szathmary EJ, Evers S, Wheatley B. Geographical distribution of diabetes among the native population of Canada: a national survey. *Soc.Sci.Med* 1990;**31**:129-39.

155. Ziskind M, Jones RN, Weill H. Silicosis. *Am.Rev.Respir.Dis.* 1976;**113**:643-65.

**Appendix A:**
Map of Nunavut, Canada

Map of Nunavut, Canada

Source: Brandson, 1994

**Appendix B:**
Questionnaire (English Version)

Interviewer: _____

_____ _____
Subject I.D. Community

DO NOT WRITE ABOVE THIS LINE

Today's Date: _____ _____ _____
Year Month Day

## I. PERSONAL CHARACTERISTICS

The following information will help us to keep in touch with you and will be important to us as we measure your health status. It is confidential and will not be released to another party without your permission.

1. Full Name: _____ / _____
LAST FIRST

2. Address: _____

_____

3. Telephone Number: _____

4. Date of Birth: _____ _____ _____
Year Month Day

5. Sex: 1. Male ____ 2. Female ____

6. Marital Status: (check one) 1. Single ____ 2. Married (incl common law) ____
3. Widowed ____ 4. Separated/Divorced ____

7. Ethnic Origin: specify _____

8. Place of birth (community): _____

9. In what community did you spend the majority of the first 10 years of your life? _____

10. What was the highest grade you passed in school? _____ grade

11. How many years of school did you have after high school? _____ years

II. **HEALTH STATUS**

These are questions mainly about your health. Please answer YES or NO; if in doubt, please answer NO.

A. **COUGH**

1. Do you usually have a cough? 1. Yes____ 2. No____

2. Do you usually cough at all on getting up, or first thing in the morning? 1. Yes____ 2. No____

3. Do you usually cough at all during the rest of the day or at night? 1. Yes____ 2. No____

If YES to any of the above (1,2, or 3):

3.1 Do you usually cough like this most days for 3 consecutive months or more during the year? 1. Yes____ 2. No____

3.2 For how many years have you had this cough?_____ years

3.3 Does the cough occur more frequently:
1. in the morning only ____
2. at work ____
3. on return home ____
4. during sleep ____
5. no difference ____

3.4 Over the past year has the cough become:
1. worse ____
2. better ____
3. the same ____

4. Is there any particular activity or job that makes you cough?
Specify: _____
_____

B. **PHLEGM**

1. Do you usually bring up phlegm from your chest? 1. Yes____ 2. No____
2. Do you usually bring up phlegm at all on getting up, or first thing in the morning? 1. Yes____ 2. No____
3. Do you usually bring up phlegm at all during the rest of the day or at night? 1. Yes____ 2. No____

If YES to any of the above (1, 2, or 3):

3.1 Do you bring up phlegm like this on most days for 3 consecutive months or more during the year? 1. Yes____ 2. No____

3.2 For how many years have you had trouble with phlegm? _____ (number of years)

3.3 Over the past three years, is the phlegm:
1. more ____
2. less ____
3. the same ____

4. Is there any particular activity or job which makes you bring up phlegm? Specify: _____
_____

C. **BREATHLESSNESS**

1. Are you troubled by shortness of breath when hurrying on the level or walking up a short hill? 1. Yes____ 2. No____

2. Do you have to walk slower than people of your own age on the level because of breathlessness? 1. Yes____ 2. No____

If YES to 1 or 2:

2.1 Do you ever have to stop for breath when walking at your own pace on the level? 1. Yes____ 2. No____

2.2 For how many years have you suffered from shortness of breath? _____ Years

2.3 Over the past three years has it become:
1. worse ____
2. better ____
3. the same ____

D. **WHEEZING**

Does your chest ever sound wheezy or whistling:

1. When you have a cold? 1. Yes____ 2. No____

2. Occasionally apart from colds? 1. Yes____ 2. No____

3. Most days or nights? 1. Yes____ 2. No____

If YES to 2 or 3:

3.1 Is the wheeze associated with chest tightness or difficulty in breathing? 1. Yes____ 2. No____

3.2 For how many years has this wheeze been present? _____ years.

3.3 Over the past three years has it been (check one)
1. worse ____
2. better ____
3. the same ____

3.4 Does the wheeze occur mostly (check one)
1. when you work ____
2. during sleep ____
3. no difference ____

E. **CHEST TIGHTNESS**

1. Does your chest ever feel tight? 1. Yes____ 2. No____

If YES to 1:

1.1 Does this come in attacks? 1. Yes____ 2. No____

Is this associated with difficulty in breathing? 1. Yes____ 2. No____

1.3 How old were you when you had your first chest tightness? _____ age in years

1.4 Have you ever required medicine or treatment for these? 1. Yes____ 2. No____

F. **ATTACKS OF WHEEZING**

1. Have you ever had an attack of wheezing that has made you feel short of breath? 1. Yes____ 2. No____

If YES to 1:

1.1 How old were you when you had your first such attack? _____ age in years

1.2 Have you had 2 or more such episodes? 1. Yes____ 2. No____

1.3 Have you ever required medicine or treatment for the(se) attack(s)? 1. Yes____ 2. No____

1.4 During the past year, how many attacks did you have?
1. a few(1-3) ____
2. several(4-12) ____
3. many(13 or more) ____
4. almost every day ____
5. none ____

1.5 Over the past three years has the wheezing been: (check one)
1. worse ____
2. better ____
3. the same ____

III. **PAST ILLNESSES**

1. During the past three years have you had any chest illness that kept you from your usual activities for as much as a week? 1. Yes____ 2. No____

If YES to 1:

1.1 How many illnesses like this have you had in the past three years? _____ number

2. Did you have any lung trouble before the age of 16? 1. Yes____ 2. No____

3. Have you ever had one of the following:

3.1 Attacks of bronchitis? 1. Yes____ 2. No____

3.1.1 If YES, at what age was your first attack? _____ years

3.1.2 Was it confirmed by a doctor? 1. Yes____ 2. No____

3.2 Pneumonia (incl. bronchopneumonia)? 1. Yes____ 2. No____

3.2.1 If YES, at what age was your first attack? _____ years

3.2.2 Was it confirmed by a doctor? 1. Yes____ 2. No____

3.3 Asthma? 1. Yes____ 2. No____

3.3.1 If YES, do you still have it? 1. Yes____ 2. No____

3.3.2 Was it confirmed by a doctor? 1. Yes____ 2. No____

3.3.3 At what age did it start? _____ years

3.3.4 If you no longer have it, at what age did it stop? _____ years

3.3.5 If you still have it,

3.3.5.1 During the past year have you seen a nurse for it? 1. Yes____ 2. No____

3.3.5.2 During the past year have you seen a doctor for it? 1. Yes____ 2. No____

3.3.5.3 Have you taken medication for it? 1. Yes____ 2. No____

3.4 Tuberculosis (TB)? 1. Yes____ 2. No____

3.4.1 If YES, at what age did this occur? _____ years

3.4.2 Was it confirmed by a doctor? 1. Yes____ 2. No____

3.4.3 How long were you treated for tuberculosis? _____ months

4. Have you ever had any other chest illnesses? 1. Yes____ 2. No____

If YES, specify_____

5. Chest injury 1. Yes____ 2. No____

If YES, specify_____

6. Chest operation 1. Yes____ 2. No____

If YES, specify_____

7. Have you ever had:

7.1 hay fever? 1. Yes____ 2. No____

7.2 eczema? 1. Yes____ 2. No____

7.3 hives? 1. Yes____ 2. No____

8. Has a doctor ever told you that you had heart trouble? 1. Yes____ 2. No____

If YES to 8:

8.1 Have you ever had treatment for heart trouble in the past 10 years? 1. Yes____ 2. No____

9. Have you had a cold within the last week? 1. Yes____ 2. No____

If YES to 9:

9.1 Do you have a cough now? 1. Yes____ 2. No____

10. Do you have any other health problems? 1. Yes____ 2. No____

10.1 If YES, specify_____

11. Are you currently taking any medication? 1. Yes____ 2. No____

11.1 If YES, specify_____

12. The following questions are about your eyes, ears, nose, and throat.

12.1 Have you ever had any of the following eye symptoms?

| | | | |
|---|---|---|---|
| 12.1.1 | burning eyes? | 1. Yes____ | 2. No____ |
| 12.1.2 | itching eyes? | 1. Yes____ | 2. No____ |
| 12.1.3 | runny or watery eyes? | 1. Yes____ | 2. No____ |

12.1.3.1 If YES to any of the 3, what year was the last episode? _____ year
12.1.3.2 how often did symptoms occur in that year? _____ number
12.1.3.3 how long did the last episode last? _____ hours

12.2 Have you had any of the following ear symptoms?

| | | | |
|---|---|---|---|
| 12.2.1 | ear ache? | 1. Yes____ | 2. No____ |
| 12.2.2 | temporary reduced hearing in one ear? | 1. Yes____ | 2. No____ |
| 12.2.3 | burst ear drum? | 1. Yes____ | 2. No____ |
| 12.2.4 | draining from the ears? | 1. Yes____ | 2. No____ |

12.2.4.1 If YES to any of the 4, what year was the last episode? _____ year
12.2.4.2 how often did symptoms occur in that year? _____ number
12.2.4.3 how long did the last episode last? _____ hours

12.3 Have you had any of the following nose symptoms (apart from colds)?

| | | | |
|---|---|---|---|
| 12.3.1 | runny nose? | 1. Yes____ | 2. No____ |
| 12.3.2 | stuffy nose? | 1. Yes____ | 2. No____ |
| 12.3.3 | loss of smell? | 1. Yes____ | 2. No____ |
| 12.3.4 | drip at the back of the throat? | 1. Yes____ | 2. No____ |

12.3.4.1 If YES to any of the 4, what year was the last episode? _____ year
12.3.4.2 how often did symptoms occur in that year? _____ number
12.3.4.3 how long did the last episode last? _____ hours

12.4 Have you had any of the following throat symptoms? (apart from colds):

| | | | |
|---|---|---|---|
| 12.4.1 | scratchy throat? | 1. Yes_____ | 2. No_____ |
| 12.4.2 | sore throat? | 1. Yes_____ | 2. No_____ |

| | | |
|---|---|---|
| 12.4.2.1 | If YES to either of the 2, what year was the last episode? | _____ year |
| 12.4.2.2 | how often did symptoms occur in that year? | _____ number |
| 12.4.2.3 | how long did the last episode last? | _____ hours |

## V. FAMILY HISTORY

As some illnesses run in families, we would like to ask you about your family. This includes your birth mother and father, your brothers and sisters (including half-brothers and half-sisters, but not including step-brothers and step-sisters).

1. Was anyone in your family ever told that they had:

| | | 1. Yes | 2. No | 3. Don't know |
|---|---|---|---|---|
| 1.1 | Chronic bronchitis | _____ | _____ | _____ |
| 1.2 | Emphysema | _____ | _____ | _____ |
| 1.3 | Lung cancer | _____ | _____ | _____ |
| 1.4 | Asthma | _____ | _____ | _____ |
| 1.5 | Hay fever | _____ | _____ | _____ |
| 1.6 | Other allergic conditions | _____ | _____ | _____ |
| 1.7 | Tuberculosis | _____ | _____ | _____ |

## VI. PERSONAL HABITS

The following questions are about some habits which are important to us in evaluating your health. Please answer to the best of your memory.

1. TOBACCO SMOKING

| | | | |
|---|---|---|---|
| 1.1 | Did your father (who your grew up with) smoke? | 1. Yes_____ | 2. No_____ |
| 1.2 | Did your mother (who you grew up with) smoke? | 1. Yes_____ | 2. No_____ |
| 1.3 | If married, does your spouse smoke? | 1. Yes_____ | 2. No_____ |
| 1.4 | Does anyone else in your house smoke? | 1. Yes_____ | 2. No_____ |
| 1.5 | Have you ever smoked cigarettes regularly? | 1. Yes_____ | 2. No_____ |

If YES to 1.5:

| | | |
|---|---|---|
| 1.5.1 | How old were you when you first started regular cigarette smoking? | _____ years |
| 1.5.2 | On the average of the entire time you smoked, how many cigarettes did you smoke per day? | _____ cigarettes/day |
| 1.5.3 | Do you, or did you inhale the cigarette smoke? | 1. Yes_____ 2. No_____ |
| 1.5.4 | Do you smoke cigarettes now? (as of one month ago) | 1. Yes_____ 2. No_____ |

| | | |
|---|---|---|
| 1.5.4.1 | If NO to 1.5.4, how old were you when you stopped? | _____ years |
| 1.5.4.2 | If YES to 1.5.4, how many cigarettes do you smoke per day now? | _____ cigarettes/day |

1.6 Have you ever smoked a pipe regularly? 1. Yes____ 2. No____

If YES to 1.6:

1.6.1 How old were you when you first started to smoke a pipe regularly? _____ years

1.6.2 On the average of the entire time you smoked a pipe, how much pipe tobacco did you smoke per week? (2oz. per pouch) _____ oz. per week

1.6.3 Do you, or did you inhale the pipe smoke? 1. Yes____ 2. No____

1.6.4 Do you smoke a pipe now? (as of one month ago) 1. Yes____ 2. No____

1.6.4.1 If NO to 1.6.4, how old were you when you stopped? _____ years

1.6.4.2 If YES to 1.6.4, how much pipe tobacco are you smoking now? (pouch = 2 oz.) _____ oz. per week

1.7 Have you ever smoked cigars regularly: 1. Yes____ 2. No____

If YES to 1.7:

1.7.1 How old were you when you started smoking cigars regularly? _____ years

1.7.2 On the average of the entire time you smoked cigars, how many did you smoke per week? _____cigars/week

1.7.3 Do you, or did you inhale the cigar smoke? 1. Yes____ 2. No____

1.7.4 Do you smoke cigars now? 1. Yes____ 2. No____

1.7.4.1 If NO to 1.7.4, how old were you when you stopped? _____years

1.7.4.2 If YES to 1.7.4, how many cigars are you smoking now? _____ cigars/week

## VII. YOUR HOME

1. How long have you lived in your present home? _____/_____ years months

2. How many years have you lived in this community? _____/_____ years months

3. When was your present home built? (check one)

1. Before 1960 _____
2. 1961-1970 _____
3. 1971-1980 _____
4. 1981 or later _____
5. don't know _____

4. Which best describes the building in which you live? (check one)

1. ____ a mobile home or trailer
2. ____ a one family house detached from any other house
3. ____ a one family house attached to one or more houses
4. ____ a building for two families
5. ____ a building for five or more families
6. ____ a boat, tent, van
7. ____ other: Specify _____

5. Does your home have any of the following?

1. central heating 1. Yes ____ 2. No ____
2. ducted air heating 1. Yes ____ 2. No ____
3. other type of heating 1. Yes ____ 2. No ____ If Yes, specify _____

6. Which of the following fuels do you USUALLY use for heating or for hot water? (check one)

1. open coal, coke or wood fire ____
2. open gas fire ____
3. electric heater ____
4. paraffin heater ____
5. gas-fired boiler ____
6. oil-fired boiler ____
7. other: ____ Specify _____

7. What kind of stove do you MOSTLY use for cooking? (check one)

1. coal, coke or solid fuel ____
2. gas ____
3. electric ____
4. paraffin ____
5. other: ____ Specify _____

8. Do you have an extractor fan over the cooker? 1. Yes ____ 2. No ____

8.1 If YES, when cooking, do you use the fan? (check one)

1. all of the time? ____
2. some of the time? ____
3. none of the time? ____

8.2 Does the fan take the fumes outside the house? 1. Yes ____ 2. No ____

9. Has there ever been any water damage to the building or its contents, for example, from broken pipes, leaks or floods? 1. Yes ____ 2. No ____

9.1 If YES, has there been any water damage in the last 12 months? 1. Yes ____ 2. No ____

10. Has there ever been mould or mildew on any surface, other than food, inside the home? 1. Yes ____ 2. No ____

10.1 Which rooms have been affected? (check all that apply)

1. bathrooms(s) ____
2. bedrooms(s) ____
3. living area(s) ____
4. kitchen ____
5. basement or attic ____
6. other: ____ Specify _____

10.2 Has there been mould or mildew on any surfaces inside the home on the last 12 months? 1. Yes ____ 2. No ____

11. Do you use a humidifier, including any humidifier system built into your heating system? 1. Yes ____ 2. No ____

11.1 If YES, What type of humidifier do you usually use? (check one)

1. humidifier built into heating system? ____
2. portable cold mist (ultrasonic or spinning disc) ____
3. portable hot mist vaporizer ____
4. other: ____ Specify_____

11.2 Under what circumstances do you use your humidifier?

11.2.1 when someone is ill - in their room 1. Yes ____ 2. No ____
11.2.2 to humidify the house 1. Yes ____ 2. No ____
11.2.3 other: 1. Yes ____ 2. No ____
If Yes, specify _____

## VIII. ANIMALS, DUST AND FEATHERS

1. When you are near animals, such as dogs, caribou, or moose, near feathers, including pillows, quilts or duvets, or in a dusty part of the house, do you ever

| | | |
|---|---|---|
| 1.1 | start to cough? | 1. Yes ____ 2. No ____ |
| 1.2 | start to wheeze? | 1. Yes ____ 2. No ____ |
| 1.3 | get a feeling of tightness in your chest? | 1. Yes ____ 2. No ____ |
| 1.4 | start to feel short of breath? | 1. Yes ____ 2. No ____ |
| 1.5 | get a runny or stuffy nose or start to sneeze? | 1. Yes ____ 2. No ____ |
| 1.6 | get itchy or watering eyes? | 1. Yes ____ 2. No ____ |

## IX. GRASS, PLANTS, FLOWERS AND POLLEN

1. When you are near grass or flowers, or when there is a lot of pollen about, do you ever

| | | |
|---|---|---|
| 1.1 | start to cough? | 1. Yes ____ 2. No ____ |
| 1.2 | start to wheeze? | 1. Yes ____ 2. No ____ |
| 1.3 | get a feeling of tightness in your chest? | 1. Yes ____ 2. No ____ |
| 1.4 | start to feel short of breath? | 1. Yes ____ 2. No ____ |
| 1.5 | get a runny or stuffy nose or start to sneeze? | 1. Yes ____ 2. No ____ |
| 1.6 | get itchy or watering eyes? | 1. Yes ____ 2. No ____ |

1.6.1 If YES to any of the 6, which time of year does this happen?

| | | |
|---|---|---|
| 1. | winter | 1. Yes ____ 2. No ____ |
| 2. | spring | 1. Yes ____ 2. No ____ |
| 3. | summer | 1. Yes ____ 2. No ____ |
| 4. | autumn | 1. Yes ____ 2. No ____ |

## X. OCCUPATIONAL EXPOSURES

1. Have you ever had to change or leave your job because it affected your breathing? 1. Yes ____ 2. No ____

1.1 If YES, list the jobs, what did they involve, what kind of industry and time of exposure?

| Type of Job | What Job Involved | Type of Industry/Business | Exposure Months/Years |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

2. Have you ever worked in a job which exposed you to vapours, gas, dust or fumes? 1. Yes ____ 2. No ____

2.1 If YES, list the jobs, what did they involve, what kind of industry, time of exposure and type of exposure?

| Type of Job | What Job Involved | Type of Industry/Business | Exposure Time Months/Years | Type of Exposure |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## XI. STONE CARVING

1. Have you ever carved stones to make artworks? 1. Yes ____ 2. No ____

If NO, go to Q.2
If YES, answer the rest of Q.1

1.1 Have you done this for at least 6 months? 1. Yes ____ 2. No ____

1.2 Have you ever sold your stone carvings? 1. Yes ____ 2. No ____

1.3 For how many years have you been a carver? _____ years

1.4 Approximately how many carvings have you made (an estimate is OK)? _____ carvings

1.5 Are your carvings usually (check one):
____ Large
____ Medium
____ Small
____ Variable

1.6 Do you usually use local stones for carving? 1. Yes ____ 2. No ____

1.6.1 Do you bring in stones from <u>other areas</u> for your carving? 1. Yes ____ 2. No ____

1.6.1.1 If YES, specify area(s) (If you <u>usually</u> use stones from the are, please circle it) _____

_____

1.7 Do you use power tools for carving? 1. Yes ____ 2. No ____

1.7.1 If YES, how long have you used power tools for carving? _____ years, or, since I started____

1.8 Do you use power tools for sanding? 1. Yes _____ 2. No _____

1.8.1 If YES, how long have you used power tools for sanding? _____ years, or, since I started____

1.9 Where do you usually carve in the summer? (check one)

1. ____ outdoors
2. ____ indoors (separate room in the house)
3. ____ indoors (not separate room)
4. ____ indoors (separate building)
5. ____ group studio
6. ____ other (specify: _____)
7. ____ do not carve in the summer

1.10 Where do you usually carve in the winter? (check one)

1. ____ outdoors
2. ____ indoors (separate room in the house)
3. ____ indoors (not separate room)
4. ____ indoors (separate building)
5. ____ group studio
6. ____ other (specify: _____)
7. ____ do not carve in the winter

1.11 Does the stone dust ever make you:

1.11.1 cough? 1. Yes ____ 2. No ____

1.11.2 bring up phlegm from your chest? 1. Yes ____ 2. No ____

1.11.3 wheeze? 1. Yes ____ 2. No ____

1.11.4 feel short of breath? 1. Yes ____ 2. No ____

1.11.5 feel tight in the chest? 1. Yes ____ 2. No ____

1.12 Do you wear a dust mask? 1. Yes ____ 2. No ____

1.12.1 If YES, do you wear it: (check one)

1. ____ Always when you are carving or sanding?

2. ____ Most of the time when you are carving or sanding?

3. ____ Some of the time when you are carving or sanding?

4. ____ Not very often when you are carving or sanding?

1.12.2 Have you ever had difficulty with your dust mask freezing up in the winter? 1. Yes _____ 2. No _____

2. Have you been exposed to dust from other people carving stones, now or in the past? 1. Yes ___ 2. No___

2.1 If YES, where did this happen? (check and answer all that apply)

| | NUMBER OF YEARS | HOW OFTEN (check one) | | |
|---|---|---|---|---|
| | | Every Day | At Least Once a Week | Less Than Once a Week |
| 2.1.1 ___ In my parents home while growing up | _____ | _____ | _____ | _____ |
| 2.1.2 ___ In other places while growing up | _____ | _____ | _____ | _____ |
| 2.1.3 ___ In my home as an adult | _____ | _____ | _____ | _____ |
| 2.1.4 ___ In other places as an adult | _____ | _____ | _____ | _____ |

3. Do you ever carve with ivory? 1. Yes _____ 2. No _____

4 Do you ever carve with bone? 1. Yes _____ 2. No _____

5. Do you ever carve with antlers? 1. Yes _____ 2. No _____

6. Have you ever injured your eye while carving? 1. Yes _____ 2. No _____

6.1 Was there any permanent damage to your eyesight? 1. Yes _____ 2. No _____

7. Have you ever had an infection in your hands or arms from carving? 1. Yes _____ 2. No _____

8. Have you ever cut yourself while carving? 1. Yes _____ 2. No _____

8.1 How many times? _____ times

8.2 Did it ever require stitches? 1. Yes _____ 2. No _____

8.2.1 How many times? _____ times

8.3 Was there any permanent damage? 1. Yes ____ 2. No ____

THANK YOU VERY MUCH FOR YOUR PARTICIPATION

**Appendix C:**
Acceptability and Reproducibility Criteria (ATS 1994)

Summary of Acceptability and Reproducibility Criteria (ATS 1994)

| Acceptability Criteria | To be considered acceptable manoeuvres must have: |
|---|---|
| Artifact free | • No cough or glottis closure during first second of exhalation<br>• No early termination or cut-off<br>• Variable effort<br>• No leaking<br>• No obstruction of the mouthpiece |
| Satisfactory Start-of-test | • Extrapolated volume <5% of FVC or 0.15L whichever is greater<br>• No hesitation at start of exhalation |
| Satisfactory End-of-test | • >6 sec. Exhalation and/or a plateau in the volume/time curve > 1 sec. In duration; or<br>• Reasonable duration or a plateau in the volume/time curve; or<br>• If the subject cannot or should not continue |
| 3 acceptable tests performed | • After 3 acceptable tests have been performed apply reproducibility criteria to each of them |

| Reproducibility Criteria | At least 2 manoeuvres must meet the reproducibility criteria: |
|---|---|
| FVC acceptable | • 2 largest FVC must be within 0.2L of each other |
| $FEV_1$ acceptable | • 2 largest $FEV_1$ must be within 0.2L of each other |
| Reproducibility criteria met | • If reproducibility criteria are met, the test session may be concluded. |
| Reproducibility criteria not met | • If reproducibility criteria are not met testing must continue until they are met; or<br>• 8 tests have been performed with no signs of meeting the reproducibility criteria; or<br>• The subject cannot or should not continue.<br>• Save 3 best manoeuvres at minimum. |

**Appendix D:**
Participant Information about the Study

UNIVERSITY OF ALBERTA

## Lung Health Among Stone Carvers and Other Adults in Nunavut

Researchers: Patrick Hessel, PhD (University of Alberta)
Francis Green, MD (University of Calgary)
Robert Cowie, MD (University of Calgary)

## INFORMATION ABOUT THE STUDY

Healthy lungs are important for an active, healthy life. There are many things that can affect the health of people's lungs. In every group of people there are some with healthy lungs and some whose lungs are not so healthy. We want to study the health of the lungs of certain people in Nunavut. We want to study people who have done stone carving and other similar people who are not stone carvers.

We will ask you to answer some questions about your lungs and about jobs that you have had. We will also ask about other things like the house you live in, smoking, and medicines that you might be taking. A member of the community specially trained for this study will ask the questions. You may be contacted later to check on some of the answers on the questionnaire.

You will also be asked to have a breathing test. The test involves blowing into a tube that measures how much air comes out of your lungs and how fast it comes out. It is a very simple test. A researcher at the health centre will conduct the breathing tests.

You will be asked to produce a sample of your sputum. This will involve coughing up some sputum and spitting it into a clean container.

You will be asked to get a chest x-ray. Chest x-rays are very simple procedures and are quite safe. You will receive a small amount of radiation but there is very little chance of any problems. There will be no charge for any of the tests.

The questionnaire and testing will take about one hour. You will receive a summary of the results of any tests and a copy will be given to the nursing station if you request this. If problems that require medical attention are found with any of your tests, you will be informed.

If you are a stone carver, one of the researchers may visit the place where you carve. They will take samples of the dust in the air and chips of the stone you use. They may ask you to wear a pump that will monitor the amount of dust that you breathe. They will also ask you to wear a dust mask and check to see how well it fits.

**Department of Public Health Sciences**

13-103 Clinical Sciences Building • University of Alberta • Edmonton • Alberta • Canada • T6G 2G3
Phone: (780) 492-6408 • Fax: (780) 492-0364 • http://www.med.ualberta.ca/phs/

All of the information is strictly confidential. No one outside of the study will see any of your results unless you request this. All of the information from the study will be kept by the researchers for 7 years. It will be kept in secure areas and will only be available to the research team. Your name or other identifying information will not be used in any report of the results.

If you participate in the study, you will benefit from the information coming from the tests. This information can become part of your medical record, if you would like that. The study will also help your community understand if there are any health problems in artists who work with soap stones.

You are free to participate in the study or to refuse to participate. You can quit the study at any time and don't have to answer questions if you don't want to. If you do not participate, your regular medical care will not be affected. The study has been approved by the Nunavut Research Institute. It has been funded by the National Health Research and Development Program.

If you have any questions you may contact any of the following people:


Dr. Patrick Hessel at the University of Alberta: Telephone - 780-407-7135
FAX - 780-407-3608

Address: Alberta Asthma Centre
Box 4033
Edmonton, Alberta T6E 6K2

Dr. Francis Green at the University of Calgary: Telephone - 403-220-4514
FAX - 403-270-8928

Address: Calgary, Health Sciences Centre
3330 Hospital Drive NW,
Calgary, Alberta T2N 4N1


If you have concerns and would like to speak to someone not involved in the study, you may contact:


Dr. Tom Noseworthy at the University of Alberta: Telephone - 780-492-6408
FAX - 780-492-0364

Address: Department of Public Health Sciences
13-103 Clinical Sciences Building
Edmonton, Alberta T6G 2G3

**Appendix E:**
Consent Form

UNIVERSITY OF ALBERTA

## CONSENT FORM

**Part 1 (to be completed by the Principal Investigator):**

| | | | |
|---|---|---|---|
| Title of Project: | Evaluation of Respiratory Hazards in Carvingstone Workers | | |
| Principal Investigator: | Patrick A. Hessel, PhD | University of Alberta | (780) 407-7135 |
| Co-Investigators: | Francis HY Green, MD | Pathology/University of Calgary | (403) 220-4514 |
| | Robert L. Cowie, MD | Medicine/Pulmonary/University of Calgary | (403) 220-8981 |

**Part 2 (to be completed by the research participant):**

| | | |
|---|---|---|
| Do you understand that you have been asked to be in a research study? | Yes | No |
| Have you read and received a copy of the attached Information Sheet? | Yes | No |
| Do you understand the benefits and risks involved in taking part in this research study? | Yes | No |
| Have you had an opportunity to ask questions and discuss this study? | Yes | No |
| Do you understand that you are free to refuse to participate or withdraw from the study at any time? You do not have to give a reason and it will not affect your care. | Yes | No |
| Has the issue of confidentiality been explained to you? Do you understand who will have access to your records? | Yes | No |
| Do you want the investigator(s) to send a summary of your results to the Nursing Station? | Yes | No |

This study was explained to me by: _____

I agree to take part in this study.

| _____ | _____ | _____ |
|---|---|---|
| Signature of Research Participant | Date | Witness |
| _____ | | _____ |
| Printed Name | | Printed Name |

I believe that the person signing this form understands what is involved in the study and voluntarily agrees to participate.

| _____ | _____ |
|---|---|
| Signature of Investigator or Designee | Date |

THE INFORMATION SHEET MUST BE ATTACHED TO THIS CONSENT FORM AND A COPY GIVEN TO THE RESEARCH SUBJECT

**Department of Public Health Sciences**

13-103 Clinical Sciences Building • University of Alberta • Edmonton • Alberta • Canada • T6G 2G3
Phone: (780) 492-6408 • Fax: (780) 492-0364 • http://www.med.ualberta.ca/phs/

**Appendix F:**
Study Newsletter (September 2001)

September 25, 2001

# Stone carver Study

"A study looking at the lung health of Inuit artists"

## What is this study about?

We all enjoy taking a deep breath when we get up in the morning, as well as being active, but some people have a more difficult time breathing than others. There are many things which can affect the health of people's lungs, including activities such as smoking, and exposure to viruses and bacteria. In this study we are looking at the health of the lungs of certain adults in Nunavut. We are studying people who have done stone carving, and other similar people who are not stone carvers. This letter is intended to keep you informed as our study progresses.

Sometimes dust can affect the way we breathe. Around the world, studies have looked at the affects of dusts on lung health in certain occupations, such as mining. Carvers are of interest due to the large amounts of dust that can be inhaled while working. The objective of this study is to determine whether stone carvers have an increased prevalence of respiratory problems that may be related to their work. **We are not assuming we are going to find any problems with dusts and carving; we are just taking a look.**

Between February and May, 2001, our researchers traveled to four communities in Nunavut: Baker Lake, Gjoa Haven, Taloyoak and Cape Dorset. The following information was collected from participants:

- A questionnaire (survey) asked participants' many questions such as: carving history and safety practices, if they've had any breathing problems, if they smoke and family health history.
- Participants underwent a lung test that measures how much air they breathe out of their lungs, as well as a chest x-ray.
- Carving areas were visited to take samples of the dust produced during carving.

Carving is so much a part of the culture and economy of Nunavut. Making sure that the lung health of the artists and the safety of their working conditions is of great importance.

### Project Team:


Dr. Patrick Hessel,
University of Alberta

Dr. Francis Green,
University of Calgary

Dr. Ken Yoshida,
University of Calgary

Dr. Robert Cowie,
University of Calgary

Dennis Michaelchuk and Karen Tofflemire,
University of Alberta

Faith Studds and Marilyn Dixon,
Field Researchers



**Approved by the Nunavut Research Institute, Research License #0500400N-M**

Project Funded by the Canadian Institutes of Health Research


### Thank-You!!!


Thank-you to all those who took part in this study! It is wonderful to see so many people taking an active interest in their health!

Thanks to the 464 participants who took the time to share all their information. Thanks as well goes to the many individuals in the communities who conducted the interviews and later returned to clarify any missing information.

Special thanks to the nurses and staff at the four health centres for sharing their time and energy. Gratitude is also extended to the various Hamlets, Baffin Regional Hospital and individuals who took the time to help our field researches do their job!

## Preliminary descriptive results:

464 people took part in this study, from four communities in Nunavut:

| | |
|---|---|
| Baker Lake: | 124 people |
| Gjoa Haven: | 66 people |
| Taloyoak: | 65 people |
| Cape Dorset: | 209 people |
| Total: | 464 people |

Males: 265 (57%)

Females: 199 (43%)

The information that was collected from study participants (the questionnaires and information from the breathing tests and x-rays) will help tell us about the lung health of adults in the communities.

**All of this information is confidential, meaning that no one outside of the study will see any of the personal results. The results will be reported for the population (everyone's answers combined), and not individuals.**

We can make statements about what we find, such as the average age of the participants, or how many carvers and non-carvers were in the study. Data analysis also allows us to compare things. For example, we can compare lung health between carvers and non-carvers with results from the breathing tests, and reported symptoms on the questionnaire . We will also explain how carvers are exposed to dusts while working on different kinds and sizes of stone materials, and using different kinds of tools under typical weather conditions. Many carvers already use masks and other protective devices. The benefits of using protective devices will be summarized.

We will then present the results in a report, with graphs and writing to help explain anything we find. These results can be reported in both English and Inuktitut.

## Health &Lifestyle

- The average age of participants in this study is 52 years old. The youngest participant is 35 years old and the oldest is 88 years old.
- Most people have lived in their community for an average of 39 years.
- Most people in this study had smoked at some point in their life (92%). Many people have quit smoking over the years (excellent!). However, 62% of people in this study currently smoke.
- For those who do smoke, the average number of cigarettes smoked per day is 13.
- The average age for starting smoking was 17 years old. For those who quit smoking, the average age to quit was 46 years old.


**For any questions or concerns contact:**

Karen Tofflemire,
Alberta Asthma Centre, University of Alberta
11402 University Ave. Aberhart 1
Edmonton, AB T6G 2J3
Phone: 780-407-6654 E-mail: kmt2@ualberta.ca
Fax: 780-407-3608


## Carving

**How many carvers took part in this study?**

232 carvers took part

**How long have they been carving?**

The average amount of time that people carved for is 18 years. Some people are just starting, while others have been carving for a very long time!

**Where are they carving?**

Most people carving in the summer did so outdoors (95 %). In the winter, about 86% of carvers worked outdoors.

**Is anyone using power tools?**

Yes. 65% of carvers use power tools for carving. Only about 15% of carvers use power tools for sanding.

**Is anyone wearing a mask for carving?**

Yes. About 58% of carvers wear a mask. Of these carvers, some wear a mask all the time (28%), while others don't wear it very often (16%)..

**Do carvers have difficulty with their masks in the cold?**

46% of those carvers wearing masks in our survey stated that they had difficulties with their mask freezing up in the winter.

**What materials are being used for carving?**

All carvers used stone as the primary medium, in addition, 68% of carvers used ivory, antler and bone in their art.

**Appendix G:**
Prediction Equations from Crapo (1981)

Prediction Equations from Crapo (1981)

**Males:**

$FVC = 0.06*H - 0.0214*A - 4.65$ (SEE = 0.644)

$FEV_1 = 0.0414*H - 0.0244*A - 2.19$ (SEE = 0.490)

$FEV_1/FVC = -0.13*H - 0.152A + 110.49$ (SEE = 4.780)

$FEF_{25-75} = 0.0204*H - 0.038*A + 2.133$ (SEE = 0.960)

**Females:**

$FVC = 0.0491*H - 0.0216*A - 4.65$ (SEE = 0.390)

$FEV_1 = 0.0342*H - 0.0255*A - 1.578$ (SEE = 0.330)

$FEV_1/FVC = -0.202*H - 0.252A + 126.58$ (SEE = 5.260)

$FEF_{25-75} = 0.0154*H - 0.046*A + 2.683$ (SEE = 0.792)

Note:

H = height

A = age